Volume 21, Number 19, October 15, 1967

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director. Published by the USAEC Division of Technical Information Extension, Robert L. Shannon, Extension Manager.

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Index References

All index entries refer the reader to volume and abstract number:

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FOURRIER, Alain
  Radioactive chain of mass number 189,  21:10023
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Personal Authors

Every author's name is indexed in the form appearing on the document abstracted:

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MONTH, M.
  Theory of gradient perturbations in AGS,  21:9872 (BNL-
    10899)
MONTH, Melvin
  Simple relativistic calculation of the electromagnetic
    form factors of the deuteron,  21:9744
```

Subjects

The subject index consisting of specific materials, objects, and processes is arranged alphabetically. Modifying phrases specific to these subjects in turn are arranged alphabetically under the subjects.

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SHEEP
  radiation dosimetry in, measurement of lethal dose of x,
    21:8905(R) (AD-631189)
  radiosensitivity of hematopoietic system of, x,
    21:8905(R) (AD-631189)
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SHELTERS
  construction of, for civil defense,  21:8838
  design of fallout,  21:8777(R) (AD-629736)
  design of shaft closure for,  21:8563(P)
  determination of configuration of, for ventilation,
    21:8779(R) (AD-629928)
  equipment for fallout, minimal requirements of,
    21:8782(R) (AD-631424)
  evaluation of fallout, for fire and air blast damage,
    21:8560 (URS-658-3)
  fire resistance of components of, evaluation of,
    21:8789(R) (AD-642241)
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Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

8500 (Y-1561) MIXING AND SAMPLING ENRICHED ^{235}U FLUIDS IN CYLINDRICAL STORAGE CONTAINERS. Final Report. Harrell, J. E. **(Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant).** Jan. 17, 1967. Contract W-7405-eng-26. 124p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

is indexed as:

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UNION CARBIDE CORP., OAK RIDGE, TENN.  Y-12 PLANT.
  Mixing and sampling enriched 235U fluids in cylindrical
    storage containers,  21:8500 (Y-1561)
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Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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TID-
  3311(Suppl.  21-8567   Dep. mn. CFSTI $3.00 cy, $0.65 mn
    2)
  22298        21-9915   Nucl. News, 9: No. 12, 17-21 (Dec.
                           1966)
  22298        21-9914   Nucl. News, 10: No. 1, 17-20(Jan.
                           1967)
  23267        21-9702   Phys. Rev., 152: 1171-82(Dec. 23,
                           1966)
  23287        21-8498   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23420        21-8764   Lancet, 2: 672-5(Sept. 24, 1966)
  23474        21-8528   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23478        21-8641   Dep. mn. CFSTI $3.00 cy, $0.65 mn
  23482        21-9471   Dep. mn. CFSTI $3.00 cy, $0.65 mn
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CHEMISTRY

Analytical Chemistry

Refer also to abstracts 34252, 34342, 34529, 34739, 34954, and 35467.

34208 (AAEC/TM-374) ABSOLUTE ACTIVITY MEASUREMENTS OF MOLYBDENUM 99 AND 4π-γ ION CHAMBER MEASUREMENT OF TECHNETIUM 99m AND OF MOLYBDENUM 99 WITH INGROWN TECHNETIUM 99m. Lowenthal, G. C.; Robson, J.; Deshpande, R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1967. 14p. Dep.

The activity of molybdenum-99, freshly separated from technetium, was absolutely measured to ±1.8% by $4\pi\beta$-γ coincidence counting. Internal conversion effects were allowed for and the completeness of the separation checked from the growth rate of technetium-99m activity as measured in a 4π gamma ionization chamber. The chamber was calibrated for molybdenum-99 with ingrown technetium-99m and for pure technetium-99m and serves for routine activity measurements of solutions of these nuclides to an accuracy of ±3%. (auth)

34209 (AWRE-O-28/67) COMPUTED f(χ) CURVES FOR THE CORRECTION OF X-RAY ABSORPTION IN ELECTRON-PROBE MICROANALYSIS. Ranzetta, G. V. T.; Scott, V. D. (Atomic Weapons Research Establishment, Aldermaston (England)). June 1967. 19p. Dep. CFSTI. UK 3s. 0d.

Electron-probe microanalysis results normally have to be corrected for the absorption of x rays in the specimen being analyzed to make them fully quantitative. This correction may be carried out using f(χ) curves which give the fraction of the generated x rays that emerge at the surface of a sample as a function of probe voltage, mass absorption coefficient, and take-off angle. A series of f(χ) curves was calculated using the computer program of Archard and Mulvey (Archard and Mulvey: Proceedings of The Third International Symposium on X-Ray Optics and X-Ray Microanalysis, Stanford Univ., 1962). These curves, covering a wide range of elements and probe voltages, should provide a useful guide to x-ray absorption in pure metals. (auth)

34210 (BNWL-SA-1121) WHAT CAN BE DETECTED. Nicholson, W. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 25, 1967. Contract AT(45-1)-1830. 20p. (CONF-670518-2). Dep. CFSTI.

From 18th Annual Mid-America Symposium on Spectroscopy, Chicago, Ill.

The threshold of sensitivity of an analytical method is discussed using appropriate probability and statistical theory. Frequency distributions, detection criterion, minimum detectable concentration, and an example, the detection of radioactivity, are discussed. Minimum detectable concentrations for multi-source problems are considered. (M.C.G.)

34211 (CEA-R-3056) QUELQUES METHODES DE DETECTION DES CORPS FISSILES. (Some Methods for the Detection of Fissionable Matter). Guery, Marcel (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1967. 214p. (In French). Dep.

Thesis.

A number of equipment or processes allowing uranium or plutonium to be tested in industrial plants, and in particular for solution concentrations to be measured, are studied. Each method has its own field of applications and its own efficiency, which are defined by calculations and by experiments. The following topics are discussed: γ-absorptiometer with an Am source, detection tests by neutron multiplication, apparatus for measurement of the α activity of a solution, fissionable matter detection by γ emission, and fissionable matter detection by neutron emission. (auth)

34212 (ORO-656) URANIUM HEXAFLUORIDE SPECIFICATIONS STUDIES. An AEC Program Status Report. (Oak Ridge Operations Office (AEC), Tenn.). July 12, 1967. 41p. Dep. CFSTI.

The results of studies made by the Uranium Hexafluoride Specifications Study Committee are discussed. Recommendations are also included. Information is included on: need for specifications; current specifications for UF_6 delivered to the AEC; analytical procedures; formation of ^{232}U in power reactors; ^{236}U in gaseous diffusion cascades; formation and separation of transuranic elements; transuranic problem in the gaseous diffusion plants; sorption for removing impurities; and flow tests. (P.C.H.)

34213 (PG-REPORT-677(Rev.)) ANALYTICAL METHOD FOR THE DETERMINATION OF RADIO-RUTHENIUM IN REACTOR FUEL PROCESSING PLANT SOLUTIONS. RUTHENIUM TETROXIDE DISTILLATION). (United Kingdom Atomic Energy Authority, Sellafield (England). Production Group). 1967. 12p. Dep. CFSTI. UK 1s. 9d.

Radioruthenium, with added carrier, was separated from other fission products by distillation from an oxidizing medium. The volatile tetroxide is absorbed in hydrochloric acid, containing ethanol, a portion of the solution evaporated on a counting tray, and the activity measured. The chemical yield of the separation procedure is established by spectrophotometric measurement of the ruthenium dithio-oxamide complex. (auth) (UK)

34214 (UCID-15162) DETERMINATION OF THORIUM IN THORIUM DIOXIDE-TUNGSTEN MIXTURES. Brandt, Richard E. (California Univ., Livermore. Lawrence Radiation Lab.). June 20, 1967. Contract W-7405-eng-48. 7p. Dep. CFSTI.

A double-fusion technique was used for the dissolution of thorium dioxide-tungsten mixtures prior to the titrimetric determination of thorium. The tungsten was dissolved with an initial $NaOH-NaNO_3$ fusion leaving a gelatinous thorium hydroxide or flocculent thorium dioxide precipitate. After filtering, the thorium precipitate was fused with $K_2S_2O_7$. The soluble thorium was then titrated with a standard EDTA solution. (auth)

34215 (UCRL-50006-67-1) ANALYTICAL CHEMISTRY SECTION PROGRESS REPORT, JANUARY 1-DECEMBER 31, 1966. Harrar, J. E. (comp. and ed.) (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 13, 1967. Contract W-7405-eng-48. 53p. Dep. CFSTI.

Developments are reported for studies on: automation in analytical chemistry; automation of the three-column gas chromatography; computer control for C, H, and N determinations in organic compounds; cathodic etching of metals for oxygen determination; vacuum fusion apparatus; automation of the CEC mass spectrometer; construction and testing of field operational differential mass spectrometer; modification of the coincident-field cycloidal-focusing mass spectrometer; a PDP-7 computer program for mass spectrometer data acquisition; automatic apparatus for determining He diffusion rates; powder densitometer; solution spectrum of Cf^{3+}; absorption spectra of Bk^{3+} and Bk^{4+}; homogeneous precipitation of $Be(OH)_2$; x-ray fluorescence; spectrophotofluorimetry; nuclear spin of ^{249}Bk from hyperfine structure in its emission spectrum; electron microprobe; transistorized, controlled-potential differential polarograph; modular, transistorized controlled-potential coulometer; atomic absorption and flame emission analysis; and various determinations. (P.C.H.)

34216 (RFP-Trans-27) POTENTIOMETRIC COULOMETRY AND ITS APPLICATION FOR DETERMINATION OF URANIUM AND PLUTONIUM. Schmid, E. Translated for Dow Chemical Co., Rocky Flats, Colo., from Oesterr. Chem.-Ztg., 67: 8-16(Jan. 1966). 24p. Dep. CFSTI. JCL $2.60 fs, $0.92 mf.

The theory and instrumentation for potentiometric coulometry are discussed. Data on uranium and plutonium determinations by this method are reviewed. (M.C.G.)

34217 DETERMINATION OF CERIUM IN CAST IRON USING REACTIONS WITH ALIZARINE S AND AMMONIA. Serdyuk, L. S.; Smirnaya, V. S. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol., 10: 509-11 (1967). (In Russian).

A photometric method developed for determining cerium in cast iron is based on preliminary cerium oxidation by bismuth and separation of cerium from nitric acid solution by diethyl ether followed by re-extraction and photometric determination as a complex compound with alizarine S and ammonia. The analysis takes 4 hr and makes possible the determination 0.07 to 0.15% of cerium in cast iron. (R.V.J.)

34218 DETERMINATION OF IMPURITIES IN RED PHOSPHORUS BY NEUTRON ACTIVATION AND GAMMA SPECTROSCOPY. PART II. Sorantin, H.; Patek, P. (Reaktorzentrum, Seibersdorf, Austria). Z. Anal. Chem., 229: 255-61(1967). (In German). (SGAE-CH-41/1966).

Several kinds of commercially available red phosphorus were analyzed by neutron activation and γ spectrometry. The longer living radionuclides were used for determination of the trace elements. Common impurities were antimony, arsenic, cobalt, and chromium, and one sample also contained silver and zinc. (auth)

34219 THE DETERMINATION OF ^{90}Sr IN ENVIRONMENTAL MATERIALS BY ION EXCHANGE AND PREFERENTIAL CHELATION TECHNIQUES. Ibbett, R. D. (Fisheries Radiobiological Lab., Lowestoft, Eng.). Analyst, 92: 417-22(July 1967).

An investigation was made into the conditions necessary for the preferential chelation of calcium and magnesium compared with strontium by EDTA and citric acid, and subsequent isolation of the strontium by ion exchange. This was used as a basis for a convenient method for the determination of ^{90}Sr in a wide range of environmental materials, down to levels as low as 0.001 pCi/g of material in its natural state. (auth)

34220 TABLE AND METHOD FOR DETERMINING THE TRUE TIME REPRESENTING A COUNT RATE OBSERVED IN RADIONUCLEAR COUNTING. Hoffman, B. W.; Van Camerik, S. B. (Southwestern Radiological Health Lab., Las Vegas, Nev.). Anal. Chem., 39: 1198-9(Aug. 1967). (ITR-9).

A table was compiled as an aid in selecting a time correction for the radioactive decay that occurs during counting. A value, Δt, obtained from the table when added to the clock time at the start of the count produces the true time. The table is useful whenever counting time is appreciable as compared to the half life of the radionuclide being counted, especially in reactors and in activation analysis. (P.C.S.)

34221 DETERMINING LITHIUM BY MEANS OF THE REACTIONS $^{6}Li(n,\alpha)^{3}H$ AND $^{16}O(t,n)^{18}F$. Dutov, A. G.; Lobanov, E. M.; Leushkina, G. V.; Matveeva, N. P. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 76-8(1966). (In Russian).

An aqueous LiF solution along with a standard LiF solution (150 mg per 100 ml H_2O) was irradiated at a neutron flux of 1×10^{12} sec^{-1} cm^{-2} for a period of 30 minutes. The ^{18}F activity with a half-life of 112 min was formed by the $^{6}Li(n,\alpha)^{3}H$, $^{16}O(t,n)^{18}F$ sequence of reactions. Tritons from the ^{6}Li spallation reacted with ^{16}O in the water to give ^{18}F ($T_{\frac{1}{2}}$ = 112 min). Because of the high background of activities due to impurities in the samples, it was necessary to carry the ^{18}F on a $Ca(OH)_2$ precipitate at a pH of 7.0. About 80% of the ^{18}F activity was carried by the $Ca(OH)_2$ precipitate. The 0.51 MeV annihilation peak of ^{18}F was counted. The average error of the analysis was 15 to 19%. The minimum amount of Li which can be determined by this method was 2×10^{-4}% on irradiation in a neutron flux of 10^{13} sec^{-1} cm^{-2}. Ten samples could be analyzed in a period of 2 to 3 hr. (TTT)

34222 ^{137}Cs DETERMINATION IN FISSION PRODUCTS BY DIRECT BETA-GAMMA COINCIDENCE COUNTING. Haller, W. A.; Perkins, R. W.; Nielsen, J. M. (Battelle-Northwest, Richland, Wash.). Nucl. Appl., 3: 436-43(July 1967). (BNWL-SA-946).

An instrumental method was devised and tested for the direct measurement of ^{137}Cs in fission-product mixtures. The method is based on beta-gamma coincidence counting, and involves beta counting of the mixture in a liquid or plastic scintillator while simultaneously measuring the gamma-ray spectrum with a NaI(Tl) detector-multichannel analyzer arrangement. Cesium-137 is unique among the long-lived fission products in that its decay (actually its ^{137m}Ba daughter, $T_{\frac{1}{2}}$ = 2.8 min) does not involve a prompt beta-gamma coincidence. The ^{137}Cs is then measured from a noncoincidence gamma spectrum with comparatively little interference from the other fission products. The method is not directly applicable to recently irradiated fuels but has been applied to the quantitative measurement of ^{137}Cs in 8-month-, 1.3-year- and 2.0-year-old material with standard deviations of about 3, 0.8, and 0.7%, respectively. (auth)

34223 DETERMINATION OF SODIUM IN ULTRAPURE SILICON AND SILICON DIOXIDE FILMS BY ACTIVATION ANALYSIS. Osborne, James F.; Larrabee, Graydon B.; Harrap, Victor (Texas Instruments Inc., Dallas). Anal. Chem., 39: 1144-8 (Aug. 1967).

The technique of neutron activation coupled with sensitive counting techniques was used to determine sodium in sub-nanogram amounts in very thin layers of silicon dioxide films and at the sub-ppB level in silicon. Techniques are described for incrementally removing thin layers of the oxide (50 to 200 Å), measuring the thickness of the residual oxide with an ellipsometer, and analyzing the etch solution for sodium-24 content. The production of sodium-24 from other impurities was evaluated and was found to be minor in samples used in this work. Preirradiation handling and wrapping was found to be an important factor when analyzing for sodium at these levels. (auth)

34224 SOLVENT EXTRACTION AND DETERMINATION OF MAGNESIUM IN BIOLOGICAL MATERIALS. Hahn, Kwang J.; Tuma, Dean J.; Quaife, Merton A. (Veterans Administration Hospital, Omaha). Anal. Chem., 39: 1169-71(Aug. 1967).

A combination method of solvent extraction and activation analysis is described for determination of magnesium in biological samples. A double extraction using sodium diethyldithiocarbamate and thenoyltrifluoroacetone (TTA) was used in isolating Mg from rat liver, tissue, and serum, prior to irradiation. Effects of pH variation on the extraction was investigated as well as the extent of interference from the $^{27}Al(n,p)^{27}Mg$ reactions. Effects of Ca, Cu, Mn, Na, and Zn ions were negligible even when six times the normal Mn content was added. (P.C.S.)

34225 EXTRACTION PHOTOMETRY USING OXINE AND 2-METHYL-OXINE: ANALYSIS OF ESSENTIAL NUCLEAR REACTOR MATERIALS. Motojima, K. (Japan Atomic Energy Research Inst., Tokyo). Progr. Nucl. Energy, Ser. IX, 8: Pt. 1, 49-87(1967).

Descriptions of the application are given under the following headings: general (standard procedure, specificity of oxine and 2-methyl-oxine reactions); uranium (determination of small amounts, determination of metal impurities, uranium base alloys); thorium (determination of small amounts, determination of metal impurities); and analysis of reactor materials (Be, reactor water). (37 references). (UK)

34226 VOLUMETRIC DETERMINATION OF BERYLLIUM AND FREE ACIDS IN PRESENCE OF ONE ANOTHER. Bartusek, Milos; Zelinka, Jan (Purkyne Univ., Brno). Z. Anal. Chem., 229: 184-8(1967). (In German).

An indirect volumetric determination of beryllium is based on the liberation of acid by reaction with salicylate and its alkalimetric titration. Free acid in Be solutions can also be titrated alkalimetrically after masking of Be with fluoride. For the determination of free acid and beryllium in presence of each other an aliquot is used for the determination of free acid after addition of fluoride and another one for the determination of the sum of Be and free acid after addition of salicylate. Relative errors are ±2% at the most. Al, Ti, Fe, U, and other ions forming strong complexes with salicylate interfere with the beryllium determination. La and Zn can be masked by oxalate. Mg can be present in a 10-fold excess. (auth)

34227 DETERMINATION OF TRACES OF IMPURITIES IN BERYLLIUM AND URANIUM BY SPARK MASS SPECTROMETRY. Bourguillot, R.; Cavard, A.; Cornu, A.; Stefani, R. (CEN, Grenoble, France). Chim. Anal. (Paris), 49: 315-19(June 1967). (In French).

Spark mass spectrometry was applied with success to very different materials such as beryllium and uranium, giving, without a standard, a semi-quantitative determination of all impurities in the parts per million range. For some elements, the comparison with other analytic methods are accuracy coefficients which helped to improve the precision of the results. (auth)

34228 A METHOD OF PRETREATMENT FOR THE DETERMINATION OF TRACE IMPURITIES (Cu,Au) IN HIGH-PURITY

GALLIUM BY NEUTRON ACTIVATION ANALYSIS. Nagy, Lajos Gyorgy; Schiff, Ervin (Muszaki Egyetem Fizikai-Kemiai Tanszeke, Budapest). Magy. Kem. Foly., 73: 188(Apr. 1967). (In Hungarian).

Anhydrous gallium trichloride prepared by reacting the metal with chlorine gas was distilled from a quartz vessel before irradiation. This procedure left the trace quantities of copper and gold unchanged and at the same time the amount of gallium decreased two orders of magnitude. (auth)

34229 SOME TECHNIQUES IN THE SEPARATION OF INORGANIC IONS IN BIOLOGICAL MATERIAL. Toribara, Taft Y. (Univ. of Rochester, N. Y.). Separ. Sci., 2: 283-92(1967).

Three separation procedures, precipitation, absorption on an ion-exchange resin, and liquid-liquid solvent extraction, are described in detail. The three procedures are treated from the standpoint of the distribution of the ion between two immiscible phases. Examples of these techniques are given. (auth)

34230 DIRECT ELECTRON EXCITATION IN ISOTOPIC X-RAY FLUORESCENT ANALYSIS. Martin, Troy C.; Blake, Kenneth R.; Morgan, I. L. (Texas Nuclear Corp., Austin). Nucl. Appl., 3: 444-5(July 1967).

A method for increasing the sensitivity of the isotopic x-ray fluorescence technique of elemental analysis is described. A vacuum path and an accelerating potential are utilized to permit fluorescent x-ray production in the sample by the β particles from the source. (auth)

34231 DETERMINATION OF PLUTONIUM IN Pu–Al ALLOYS BY X-RAY FLUORESCENCE. Ganivet, M.; Arnal, Th. (CEA-CEN, Cadarache, France). Anal. Chim. Acta, 39: 73-9(Sept. 1967). (In French).

An x-ray fluorescence method is described for the determination of plutonium Pu–Al alloys. In order to obtain satisfactory reproducibility, the alloy was dissolved in a nitric acid–mercury(II) nitrate mixture. The Lα emission of plutonium was measured; to eliminate matrix effects, an internal standard with a wavelength near that of the Pu emission was used. Equipment and sample preparation are described. Extension of the method to other determinations is discussed. (auth)

34232 DETERMINATION OF TRACES OF IRIDIUM IN RHODIUM BY NEUTRON ACTIVATION ANALYSIS. Gijbels, R.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 39: 89-93(Sept. 1967).

Iridium traces were determined in rhodium by thermal neutron activation for 2 days at a flux of 4×10^{11} n/cm^2/sec^1. After cooling for at least 1 week, the samples were analyzed by γ spectrometry. No radiochemical separations were required. Special attention was paid to self-absorption phenomena in the rhodium samples. (auth)

34233 NEUTRON ACTIVATION ANALYSIS FOR GOLD IN OSMIUM. Gijbels, R.; Hoste, J. (Ghent Univ.). Anal. Chim. Acta, 39: 132-5(Sept. 1967).

Methods for determining gold in osmium by neutron activation with and without chemical separation are described. After Os and Ru are distilled from boiling bromate–sulfuric acid mixture the gold remaining in the residue can be determined by γ-spectrometric analysis without further chemical separation, for its γ energy (411 KeV) differs sufficiently for that of $^{192(194)}$Ir. If chemical separation is desired, gold can be easily extracted with ethyl acetate from HCl medium. Using 2N HCl and thorough washing of the organic phase, 99 to 99.5% of the ^{198}Au was recovered. Gold can be determined in the presence of a 25-fold amount of iridium without chemical separation. After chemical separation the ratio can be increased to 100. (D.H.M.)

34234 DETERMINATION OF DYSPROSIUM IN THE PRESENCE OF ALUMINUM. Bruck, A.; Lauer, K. F. (EURATOM, Geel, Belg.). Anal. Chim. Acta, 39: 135-6(Sept. 1967).

The complexometric determination of dysprosium, in the presence of aluminum, using Xylenol Orange as an indicator is described. Aluminum was masked with sulfosalicylic acid. The titration was made with standard EDTA solution, taking the sharp color change from red to yellow-orange as the end-point. To obtain a sharp end-point and reproducible results the pH of the solution at the start of the titration must be adjusted with ammonia solution to a value of 6.0 ± 0.3 (pH meter) and for 100 mg of Al present per titration, 10 ml of the sulfosalicylic acid solution should be added. (D.H.M.)

34235 ANALYSIS OF THE HEAVY ELEMENT IN ALLOYS AND ORES BY BETA RAY BACKSCATTERING. Balakrishnan, B. R.; Balasubramanian, V. (Indian Inst. of Tech., Bombay). Mater. Eval., 25: 173-6(July 1967).

Analysis for heavy elements in binary alloys and some complex systems, such as high speed steel, iron ore, and lead ore, was carried out by the beta back-scattering method using a Geiger-Mueller counter and ionization chamber. The use of absorbing filters to improve the accuracy is discussed. The accuracy of the method is comparable to that of chemical analysis. An attempt was made to test the homogeneity of metal powder mixtures. (auth)

34236 ACTIVATION ANALYSIS OF MONO- AND OLIGONUCLEOTIDES. Rushizky, George W. (National Cancer Inst., Bethesda, Md.); Miller, Warren W. Anal. Biochem., 20: 181-91 (July 1967).

Mono- and oligonucleotides from enzymic digests of RNA and DNA were separated on filter paper and their quantities determined after neutron activation of ^{31}P to ^{32}P. This procedure required about $1/_{40}$ of the material needed for the same analyses by UV spectrophotometry. (auth)

34237 MEASUREMENT OF THE URANIUM AND THORIUM CONTENT, BY ALPHA SPECTROMETRY, FOR THE DATING OF CORALS. Lalou, Claude; Mabuchi, Hisao (CNRS, Gif-sur-Yvette, France. CEN, Saclay, Gif-sur-Yvette, France). Bull. Soc. Chim. France, No. 6, 1884-7(June 1967). (In French).

The measurement of the ratio ^{230}Th/^{234}U may be used for dating corals. It is necessary to obtain this ratio very accurately. A method is described allowing the use of the same sample of coral and the same method of measurement (alpha spectrometry) for the two nuclides, avoiding the variations due to sampling. (auth)

34238 NEUTRON ACTIVATION ELECTRODEPOSITION TECHNIQUES. Berlandi, Francis Joseph. Ann Arbor, Mich., Univ. of Michigan, 1966. 147p.

Thesis.

An analytical technique that combines controlled-potential coulometric separation with neutron activation analysis is described. This technique takes advantage of the great selectivity of electrodeposition for the separation of the species of analytical interest from other constituents of a solution with the extreme sensitivity of activation analysis. Pyrolytic graphite is used as the electrode for the deposition of the species of analytical interest since it has a low capture cross section for slow neutrons and high purity. After irradiation in a reactor, this electrode material gives negligible activity. Once a metal film is deposited on the electrode disk, the combination can be irradiated. The resulting activity can easily be used to both qualitatively and quantitatively identify the material on the electrode surface through γ spectroscopy. As deposition is carried out under controlled potential conditions and the total electrolysis time is a known parameter, the initial concentration in the sample solution can be calculated accurately. Because of the negligible background of the pyrolytic graphite, the sensitivity of the method is limited by the sensitivity of the element for neutron activation analysis. The method is also applicable to the preparation of neutron flux comparators of high precision. Mössbauer spectroscopy was used to investigate the bonding of electrodeposited metals to the substrate electrode material. The method is a sensitive, nondestructive technique of examining surface bonding structure of the electrodeposited films. A knowledge of this bonding structure is necessary to increase the precision and accuracy of the previously described technique. Other aspects of the study included the development of a method for the deposition of U films in μg amounts from nonaqueous solution on the surface of an electrode. Descriptions of the unique electrode designs are given in the study. These include a holder for a pyrolytic graphite electrode designed for activation analysis, a special membrane electrode assembly, and a microcell electrode system, which is applicable for studies employing 25 μl of sample solution. All electrolysis operations are carried out under normal three electrode conditions. (Disser. Abstr.)

34239 OPREDELENIE β-AKTIVNOSTI PROB IZ BIOSUBSTRATOV METODOM GRADUIROVOCHNYKH KRIVYKH. (Determination of the β Activity of Specimens of Biosubstratum By Means of Calibrating Curves). Denisov, I. I.; Sokolova, G. I.; Safroshin, V. V.; Koshaeva, K. K. Moscow, Atomizdat, 1967. 35p.

Methods of correction for self-absorption and self-scattering are given for use in the radiometric analysis of animal tissues for the presence of β activity from ^{89}Sr + ^{90}Y, ^{144}Ce + ^{144}Pr, ^{137}Cs, ^{14}C, ^{147}Pm, and ^{233}Pa. (R.V.J.)

34240 IMPROVEMENTS IN AND RELATING TO SPECTRUM ANALYZERS. (to Philips Electronic and Associated Industries Ltd.). British Patent 1,071,993. June 14, 1967. Priority date Dec. 15, 1964, Netherlands.

A device is described for comparing two energy spectra in which the spectral components of each spectrum in the form of charac-

teristic magnitudes are registered at different places in a storage means, and means are provided for successively scanning the spectral magnitudes of each of the spectra and for subtracting the spectral magnitudes of one spectra multiplied by an adjustable weight factor from corresponding magnitudes of the other spectrum. The ratio between the scanning of the spectral magnitudes of the two energy spectra is adjustable. For the formation of a difference magnitude during each scanning period of a spectrum magnitude of one energy spectrum the spectrum magnitude is reduced by the weight average of the spectrum magnitudes of the other spectrum scanned during the period. The electrical circuitry for the device is described in detail. (B.L.M.)

34241 DEVICE FOR MEASURING THE CARBON CONTENT OF MOLTEN METAL. Kolodney, Morris (to United Nuclear Corp.). British Patent 1,073,198. June 21, 1967. Filed May 12, 1966.

A carbon monitoring device of simple construction comprises a metal tube with one end closed. The closed end of the tube is immersed in the molten metal of which the C content is to be determined. The tube is made of a metal such as pure Fe or low C steel in which C will dissolve and diffuse at the temperature of the molten metal and which is not subject to attack by the molten metal at this temperature. The interior of the tube is swept out with a decarburizing gas with gas outlet means being provided. Gas analyzing means are provided for determining the quantity of C in the gas leaving the tube. (B.L.M.)

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Refer also to abstracts 34288, 34301, 34897, and 34967.

34242 (AGN-8191(Vol.2)) ALKALI METALS EVALUATION PROGRAM. THE VAPOR PRESSURE OF LITHIUM. Achener, P. Y.; Fisher, D. L. (Aerojet-General Corp., San Ramon, Calif. Nuclear Products and Services Group). July 1967. Contract AT(04-3)-368. 21p. Dep. CFSTI.

Vapor pressure of lithium was determined at temperatures from 1881 to 2286°F and pressures from 0.96 to 7.86 psia. Although experimental difficulties prevented extension of the work to higher temperatures, the data agree with those of other investigations. (auth)

34243 (AGN-8191(Vol.6)) ALKALI METALS EVALUATION PROGRAM. THE SPECIFIC HEAT OF LIQUID SODIUM AND LITHIUM. Achener, P. Y.; Fisher, D. L. (Aerojet-General Corp., San Ramon, Calif. Nuclear Products and Services Group). June 1967. Contract AT(04-3)-368. 39p. Dep. CFSTI.

The enthalpy and specific heat of liquid Na and Li were determined at temperatures between 250 and 2150°F for sodium, and between 250 and 2100°F for lithium using a Bunsen ice calorimeter. The equation proposed for the enthalpy of Na from near the melting point to 2150°F is: $H_T^0 - H_{32°F}^0 = 44.50 + 0.3168T$ Btu/lb where T is in degrees Fahrenheit. The resulting value for the specific heat of liquid Na is: $C_p = 0.3168$ Btu/lb/°F. The equations proposed for the enthalpy of Li are: $H_T^0 - H_{32°F}^0 = -27.7 + 0.859T$ Btu/lb from 32° to 357°F (melting point), and $H_T^0 - H_{32°F}^0 = 66.42 + 1.148T - 1.010 \times 10^{-4}T^2 + 2.184 \times 10^{-8}T^3$ Btu/lb from 357°F to 2100°F. The latent heat of fusion was calculated from these equations; the value is 185.5 Btu/lb. The resulting value for the specific heat of liquid lithium is: $C_p = 1.148 - 2.019 \times 10^{-4}T + 6.553 \times 10^{-8}T^2$ Btu/lb/°F where T is in degrees Fahrenheit. (auth)

34244 (BNWL-228) AEC DIVISION OF RESEARCH PROGRAMS MONTHLY ACTIVITIES REPORT, FEBRUARY 1966. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1966. Contract AT(45-1)-1830. 8p. Dep. CFSTI.

Research on actinide element chemistry, radiation effects on metals, plutonium physical metallurgy research, and statistical evaluation and development is described. (M.C.G.)

34245 (CEA-R-3199) DIFFUSION DE L'IODE A TRAVERS L'EAU. EXPERIENCE PIREE. (Diffusion of Iodine in Water. The Piree Experiment). Dadillon, James; Geisse, Georges (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Apr. 1967. 22p. (In French). Dep.

Large-scale and out-of-pile experiments were conducted in a general safety program for water cooled reactors. At the bottom of a 1,200 ft^3 tank, full of demineralized water, carbon dioxide, contaminated with iodine, was injected at about 300 psi and 400°C. Under these conditions, only 0.1% of the iodine reached the surface and was released in air. Nevertheless, exchange conditions between water and air caused an additional iodine release proportional to time. (auth)

34246 (CEA-R-3210) ETUDE DES REACTIONS ClF_3–UO_2F_2 ET ClO_2F–UO_2F_2. (Study of the Reactions ClF_3–UO_2F_2 and ClO_2F–UO_2F_2). Luce, Michel; Hartmanshenn, Olivier (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1967. 30p. (In French). Dep.

The reaction between ClF_3 and UO_2F_2 is explained in terms of two secondary reactions involving the interaction between ClF and ClO_2F on UO_2F_2. The origin of the by products is indicated (ClO_2F, ClO_2, HF). (auth)

34247 (COO-1025-34) AROMATIC HYDROGEN EXCHANGE. Annual Report VI, September 1, 1965–January 14, 1967. Kresge, A. J. (Illinois Inst. of Tech., Chicago. Dept. of Chemistry). May 1967. Contract AT(11-1)-1025. 16p. Dep. CFSTI.

The proton transfer process was studied by using aromatic protonation. Activation parameters were determined for the aromatic protonation of 1,3-dimethoxybenzene with H_3O^+ and HCO_2H and of 1,3,5-trimethoxybenzene with H_3O^+ and $H_2PO_4^-$. The entropies of activation for kinetic aromatic protonation showed a striking resemblance to the entropies of ionization of the corresponding catalyst acids. Two primary hydrogen isotope effects, that on bond-breaking in the catalyzing acid and that on bond-breaking in the cationic intermediate, are discussed. Several secondary isotope effects were of consequence. Two resulted from hybridization changes in the non-reacting carbon–hydrogen bond of the aromatic substrate situated at the seat of exchange. A third secondary isotope effect was produced by changes in the strength of the non-reacting bonds of the hydronium ion. Several triphenylmethanols were labeled with deuterium in various ring positions and the extent of their ionization in strongly acidic media was measured. It was shown that the effect of isotopic substitution at the various ring positions was additive and that deuteration in the ortho and meta positions had approximately twice the influence as deuteration in the para position. The hydrolysis of vinyl ether is also discussed. (D.H.M.)

34248 (COO-1149-92) STRAIN ENERGIES AND THERMAL PROPERTIES OF GLOBULAR AND POLYNUCLEAR AROMATIC MOLECULES. Westrum, Edgar F. Jr.; Wong, Shaio-wen (Michigan Univ., Ann Arbor. Dept. of Chemistry). Apr. 1967. Contract AT(11-1)-1149. 7p. (CONF-670913-3). Dep. CFSTI.

From Symposium on New Investigations in Thermodynamics, Thermochemistry, and Transport Properties, Heidelberg, Germany.

From the measured enthalpies of combustion of bicyclo[2.2.2]-octane (8-ane) and six closely related substances plus two bicycloheptanes and four polynuclear aromatic hydrocarbons, enthalpies of formation and strain energies were calculated by several schemes. It was concluded from mechanics that the non-twisted boat form (D_{2h}) is the most stable configuration of 8-ane. Observed strain energies for 8-ane (9.20 kcal/mole) and for quinuclidine (9.46) are consistent with the presence of strain energy anticipated for the eclipsed configuration of the hydrogens. Introduction of an equatorial double bond increased the strain energy to 9.69 kcal/mole. Bicyclononane has high strain energy as a consequence of the overcrowded carbon atoms on the bridge ring. Replacement of this CH_2 by NH or O reduces the strain to 7 and 5 kcal/mole, respectively. The strain energies of biphenylene, fluoranthene, and perylene as well as bicycloheptanes were also evaluated and interpreted. (auth)

34249 (COO-1654-1) AN INVESTIGATION OF STERIC AND SYNERGIC EFFECTS IN METAL CHELATES. Technical Progress Report, September 1, 1966–April 1967. Fernando, Quintus (Arizona Univ., Tucson). Apr. 12, 1967. Contract AT(11-1)-1654. 7p. (CONF-670908-1). Dep. CFSTI.

For Presentation at 10th International Conference on Coordination Chemistry, Tokyo, Japan.

Studies were made on the properties of selected metal chelates in solution and their structures in the solid state. The metal chelates consisted of the ligand, 2-methyl-8-quinolinol, and trivalent metal ions such as Al(III), Ga(III), and In(III). Very small single crystals of the 1:2 as well as the 1:1 copper–1-(2-pyridylazo)-2-naphthol (PAN) complexes were grown from ethanol solutions. Preliminary x-ray data on the structure of the compound are given. The structure of the metal chelate adduct of bis-(acetylacetonato)-copper(II) with quinoline was also studied. It was found that adduct formation not only destroyed the planarity of the two chelate rings, but also altered the symmetry of the molecule. (P.C.H.)

34250 (GEAP-5100-5) INTERACTION OF IODINE WITH ZIRCALOY-2. Rosenbaum, H. S.; Davies, J. H.; Pon, J. Q. (General Electric Co., San Jose, Calif. Vallecitos Atomic Lab.). Jan. 1966. Contract AT(04-3)-189. 43p. (EURAEC-1845). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Evidence that localized accumulation of iodine and other fission products may promote fuel cladding failures motivated an out-of-

pile study of the reaction of Zircaloy-2 with iodine. Two types of reactions were observed: a general attack, in which the zirconium content of the cladding material is removed as zirconium iodide, and a cracking effect. The cracking appears to be a stress-corrosion phenomenon in that the stress and corrosive environment must be present simultaneously. Fracture morphology in out-of-reactor experiments were compared with those of in-pile fuel cladding failures that were observed in the High Performance UO_2 Program. Both similarities and differences were noted and no confident conclusion can be drawn regarding the association of the in-pile failures with the Zircaloy-2 iodine attack mechanism. (auth)

34251 (JUL-434-PC) EIN VERGLEICH VON TRI-N-OCTYLPHOSPHINOXID UND TRI-N-OCTYLARSINOXID ALS EXTRAKTIONSMITTEL FUER DREIWERTIGE LANTHANIDE UND ACTINIDE. (A Comparison of Tri-n-Octylphosphine Oxide and Tri-n-Octylarsine Oxide as Extraction Agents for Trivalent Lanthanides and Actinides). Blair, A. J. F.; Michael, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie). Dec. 1966. 24p. (In German). Dep.

Trioctylarsine oxide (TOASO) was prepared by Grignard synthesis; and its properties as extraction agent for trivalent lanthanides and actinides were compared with those of trioctylphosphine oxide (TOPO). The dependency of the extraction coefficients of the ions Am^{3+}, Cm^{3+}, and Pm^{3+} from the concentration of the extraction agent, of nitric acid, and of lithium nitrate was measured. The synergic effects that occur on extraction with mixtures of trilaurylamine (TLA) with TOPO or TOASO were investigated. The properties of TOASO as extraction agent are very different from those of TOPO. TOASO is a stronger base than TOPO, and its extraction properties are comparable with those of trilaurylamine. (auth)

34252 (RFP-958) SPECTROPHOTOMETRY OF NEPTUNIUM IN NITRIC ACID SOLUTIONS. Johnson, Andrew J.; Shepherd, Glenn A. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). July 7, 1967. Contract AT(29-1)-1106. 9p. Dep. CFSTI.

Studies were made of the effect of varying nitric acid concentrations in neptunium solutions on the oxidation states of the neptunium present. Spectrophotometric methods were used to determine the proportions of neptunium(IV), (V), and (VI) present in nitric acid solutions varying between one and ten normal (1 and 10 N). Absorption spectra of both the neptunium(IV) and (VI) complexes with nitrate were identified and are given. (auth)

34253 (UCID-15143) NOTES ON THE GROWTH OF LiH SINGLE CRYSTALS. Catalano, Edward; Kingman, Donald D.; Wrenn, Emmett W. (California Univ., Livermore. Lawrence Radiation Lab.). May 31, 1967. Contract W-7405-eng-48. 14p. Dep. CFSTI.

The technique used for the production of large single crystals of LiH is described. The steps are: purifying lithium metal by distillation, sealing the purified lithium metal within a pure iron crucible, hydriding the lithium metal after diffusing hydrogen through the crucible walls, growing the LiH crystals by the Störber process, and annealing the crystal before removing it from the crucible. (auth)

34254 (UCRL-17406) MAGNETIC RESONANCE SPECTRA OF VCl_4 AND OTHER PARAMAGNETIC SPECIES. Pratt, David Wixon (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1967. Contract W-7405-eng-48. 266p. Dep. CFSTI. Thesis.

Techniques for performing electron spin resonance studies of paramagnetic species in glasses or polycrystalline matrices at temperatures below the λ-point of liquid helium have been developed and the experimental procedures have been described in detail. These methods have been applied in the investigation of the transition metal compounds VCl_4 and $V(CO)_6$. The ESR spectrum of VCl_4 at liquid helium temperatures has been studied in the pure compound and in the following solvents: n-heptane, mineral oil, CCl_4, $SiCl_4$, $TiCl_4$, and $SnCl_4$. The spin Hamiltonian parameters for pure VCl_4 and VCl_4 in n-heptane and mineral oil have been obtained. These have provided significant evidence for the presence of a Jahn-Teller effect in this molecule at low temperatures. The spectra in the remaining solvents are quite complex but a partial assignment of these has been made. The effects of both static and dynamic Jahn-Teller distortions on the ESR spectra of VCl_4 in these solvents are discussed in detail. The relaxation times for the unpaired electron in VCl_4 have been measured over a wide temperature range using a variety of techniques including pulse experiments. These results are discussed in terms of the existing theories for spin relaxation in solids at low temperatures and a model for relaxation in VCl_4 in the temperature range 1 to 50°K has been proposed. In addition, an unusual self-enhancement behavior of the ESR spectrum of VCl_4 has been discovered and interpreted in terms of the above model. ^{35}Cl NMR experiments have been performed on pure VCl_4 and solutions of VCl_4 in $TiCl_4$ at room temperature and above. The temperature dependence of the chemical shift in VCl_4 has made possible the measurement of the ^{35}Cl hyperfine coupling constant in this molecule. The NMR linewidths in both VCl_4 and $TiCl_4$ have been studied as a function of temperature and the data interpreted on the basis of quadrupolar and scalar relaxation theories. Evidence is presented for the existence of chemical exchange in solutions of VCl_4 in $TiCl_4$. The ESR spectrum of $V(CO)_6$ at liquid helium temperatures has been observed in the pure material and in benzene and n-heptane glasses. Because of an unusual power dependence of the spectrum in n-pentane, both the isotropic and anisotropic g-values have been measured directly. These are compared with theoretical expressions for g for both trigonal and tetragonal distortions of the octahedron derived. The presence of a tetragonal distortion in $V(CO)_6$ is shown to be consistent with a molecular orbital description of the bonding. Evidence for the presence of back-bonding is also presented. Radicals produced by the chemical and electrolytic reduction of S_4N_4 and S_4N_3Cl have been studied by ESR and the spin Hamiltonian parameters have been obtained. The radical anion of S_4N_4 has been prepared. Finally, the ESR linewidth of $Gd(H_2O)_8^{3+}$ has been studied as a function of temperature in the range 20 to 260°C. (118 references). (auth)

34255 (UCRL-50262) APPLICATION OF THE MOESSBAUER EFFECT IN DETERMINATION OF PHASE DIAGRAMS. Howard, Ephraim Manasseh (California Univ., Livermore. Lawrence Radiation Lab.). June 1967. Contract W-7405-eng-48. 86p. Dep. CFSTI. Thesis.

Use of the Moessbauer effect in determining phase diagrams was evaluated. The nickel-gold system was selected as the basis for the study because it is well known, and corroborative data were obtained by standard x-ray diffraction techniques. ^{57}Fe was the Moessbauer isotope used. The Moessbauer spectra were obtained for one-phase quenched-in specimens over the composition range from 25 to 100 atom percent nickel, and a temperature range from 4.5 to 700°K. From these spectra, calibration curves were made of the variation in Moessbauer parameters with composition. Moessbauer spectra were then obtained for specimens equilibrated at temperatures in the range from 840 to 1040°K and quenched to retain the two-phase equilibrium composition. The nickel-gold phase diagram obtained with Moessbauer data from the two-phase specimens and the calibration curve made from the one-phase data was in good agreement with x-ray diffraction measurements and the existing Ni-Au phase diagram. Means to improve the determination of phase boundaries for other systems by use of the isomer shift, or other Moessbauer parameters are also discussed. (85 references). (auth)

34256 (UJV-1567) OTNOSITEL'NYE IZOTOPICHESKIE SMESHCHENIYA V SPEKTRAKH ERYIYA I ITTERBIYA. (Relative Isotope Shifts in the Spectra of Erbium and Ytterbium). Chaiko, Yu. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1966. 130p. (In Russian). Dep.

Isotope shifts (IS) in the spectra of erbium and ytterbium were measured by means of high resolution spectrometer with the Fabry-Perot interferometer and photoelectric recording. Intrinsic quadrupole moments of ^{162}Er and ^{168}Yb nuclei were determined. A review of the isotope effect theory in atomic spectra is presented. The design and performance of the high-resolution equipment for hyperfine structure research and for IS measurements of emission spectral lines are described. The use of highly enriched isotopes, individual spectrum excitation of different isotopes, and the nonsimultaneous record of different isotopic components makes possible a high-precision measurement even in the case of rather small IS (of the order of 1 mK). A set of test experiments was performed to find the best experimental conditions for each part of the equipment. The spectra of stable isotopes of erbium and ytterbium were studied since IS data of Er and Yb were not complete and the accuracy not too high and values of intrinsic nuclear quadrupole moments are not known for all these isotopes. The shifts of the four lines were measured in Yb spectrum. The experimental results for the resonance lines of Yb II and Yb I were used for calculating the IS constants C_{exp}. A comparison of these constants with the calculations of Frandkin and Ionesco-Pallas model yields, for the intrinsic nuclear quadrupole moment of ^{168}Yb, $Q_0(^{168}Yb) = (7.20 \pm 0,30).10^{-24}$ cm^2. About 35 lines of the Er I and Er II spectra were measured. It was not possible to calculate C_{exp}. The influence of the quadrupole effect on IS was determined comparing the relative values of IS. This yields $Q_0(^{162}Er) = (7.25 \pm 0.30).10^{-24}$ cm^2, $Q_0(^{164}Er) = (7.52 \pm 0.30).10^{-24}$ cm^2, and $Q_0(^{170}Er) = (7.66 \pm 0.30).10^{-24}$ cm^2. (auth)

34257 (USC-113P4-7) THE TRANS EFFECT AND EVIDENCE FOR LIMITING S_N1 MECHANISMS IN SUBSTITUTION REACTIONS OF Co(III) COMPLEXES. Tewari, P. H.; Gaver, Richard W.; Wilcox, H. K.; Tsiang, Hon Gee; Wilmarth, W. K. (University of Southern California, Los Angeles. Dept. of Chemistry). June 1, 1967. Contract AT(11-1)-113. 10p. (CONF-670908-2). Dep. CFSTI.

From 10th International Conference on Coordination Chemistry, Tokyo, Japan.

Studies were made on the mechanisms in substitution reactions of Co(III) complexes, such as the displacement of H_2O in $Co(CN)_4(SO_3)OH_2^{3-}$ by CN^-, rate of aquation of the NH_3 ligand in reaction with $Co(CN)_4(SO_3)OH^{4-}$, and the displacement of H_2O in $Co(DH)_2(SO_3)OH_2^-$, where DH is used to represent the formula of the conjugate base of dimethylglyoxime. The trans activation and S_N1 mechanisms for the reactions are discussed. (P.C.H.)

34258 (WAPD-316) OPTICAL ABSORPTION SPECTRA OF UO_2 AND ITS SOLID SOLUTIONS. LWB-LSBR Development Program. Berman, R. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). June 1967. Contract AT(11-1)-Gen-14. 67p. Dep. CFSTI.

The infrared absorption spectrum of UO_2 shows a complicated series of peaks, apparently arising from electronic transitions in the U^{4+} ion, as modified by the eight surrounding oxygen ions. This spectrum is modified largely by wavelength shifts as ThO_2 or ZrO_2 is added in solid solution. On oxidation (except in zirconia materials, where ordered solid solutions apparently prevent the uranium ions from being adjacent to interstitial oxygens), overall absorption increases, particularly at short wavelengths in the visible or near-infrared range. The peaks of the spectrum become ill-defined. New peaks appear at 1.60 and 1.37 microns; they are attributed to U^{5+} and U^{6+}, or oxygen complexes containing these ions. (auth)

34259 RELAXATION AND DYNAMIC NUCLEAR POLARIZATION OF PROTONS IN FREE RADICALS. Stehlik, D.; Hausser, K. H. (Max-Planck-Institut fuer Medizinische Forschung, Heidelberg). Z. Naturforsch., 22a: 914-28(June 1967). (In German).

The relaxation and dynamic nuclear polymerization (DNP) of protons inside free radicals in proton-free solvents were studied. A calculation of the DNP coupling parameter ξ is given for mixed scalar and dipolar intramolecular interaction with simultaneous time dependences by electron spin relaxation, electron spin exchange, and molecular motion. Experimental results at 12.5 kGauB were obtained for the t-butyl protons in the three radicals tri-t-butyl-phenoxyl (TBP), Coppinger's Radical (CR) or Galvinoxyl and di-t-butyl-nitroxide (DBNO). The experimental technique differed from what is usual in the NMR-detection with transient methods in pulse technique and in the use of a dielectric resonator in the microwave equipment. DNP enhancements from high positive to high negative values were observed corresponding to mixed proton-electron-coupling from dominantly scalar to dominantly dipolar interaction. All results can be at least qualitatively explained by the theory of the intramolecular interaction since the essential parameters and constants of the interaction can be measured with other independent methods. (auth)

34260 STRUCTURE AND PROPERTIES OF TECHNETIUM AND RHENIUM COMPOUNDS OF THE $[Me^{V}OX_5]^{2-}$ TYPE. I. PREPARATION, MAGNETIC, AND SPECTROPHOTOMETRIC STUDIES. Ezhovska-Tshebyatovska, B.; Vaida, S.; Valuka, M. Zh. Struct. Khim., 8: 519-23(May-June 1967). (In Russian).

Results are given of the magnetic and spectrophotometric studies of Re(V) and Tc(V) complexes of the $(MeOX_5)^{2-}$ type with X = Cl, Br, and I. (The Tc complex contained only Cl.) (tr-auth)

34261 HEAT CAPACITY OF SOME URANATES. Jakes, D.; Schauer, V. (Nuclear Research Inst., Prague). Proc. Brit. Ceramic Soc., No. 8, 123-5(June 1967).

The heat content of $MnUO_4$, $NiUO_4$, and $MgUO_4$ was measured with an isothermal drop calorimeter in the temperature range 500 to 1000°K. The equations for calculating the heat capacities in the considered interval of temperature are given. (auth) (UK)

34262 A HIGH-TEMPERATURE ADIABATIC DROP CALORIMETER. THE ENTHALPIES OF α-Al_2O_3, UC_2, AND US BETWEEN 330°K AND 1700°K. MacLeod, A. C.; Hopkins, S. W. J. (Morganite Research and Development Ltd., London). Proc. Brit. Ceramic Soc., No. 8, 15-30(June 1967).

The construction and operation of an adiabatic drop calorimeter for enthalpy measurements up to 1800°K is described. Enthalpy data determined for a sample of α-Al_2O_3 provided by the National Bureau of Standards agreed with the values calculated from the NBS corrected equation with a mean deviation of less than 0.1%. The heat capacities of UC_2 and US were derived from enthalpy measurements made over the temperature range 200 to 1500°K. (auth) (UK)

34263 THE CHEMISTRY OF URANIUM(IV). III. SOME NEW CHELATE COMPLEXES OF URANIUM(IV). Selbin, J.; Ortego, J. D. (Louisiana State Univ., Baton Rouge). J. Inorg. Nucl. Chem., 29: 1449-56(June 1967).

Several new chelate complexes of uranium(IV) were synthesized and characterized. Among these were included a very stable eight-co-ordinated complex in which two quadridentate ligands were bound to the same U(IV), $U(ensal)_2$, and a complex believed to be the first example of U(IV) bound to a phosphine ligand, $(UCl_4)_2$(diphos). All complexes reported are believed to contain eight-co-ordinated U(IV). (auth) (UK)

34264 ACTION OF ALKALI ON TRANSITION-METAL CARBIDES. Ball, M. C.; Brown, D. S.; Page, D.; Thurman, R. R. T. (Univ. of Technology, Loughborough, Eng.). Trans. Brit. Ceram. Soc., 66: 307-13(July 1967).

The reactions of sodium carbonate with carbides of Ti, Zr, Ta, Cr, Mo, and W were studied at temperatures between 550 and 900°C under vacuum. The main products were: TiO_2 from TiC, ZrO_2 from ZrC, $NaTaO_3$ from TaC, and Na_2MoO_4 and Na_2WO_4 from Mo_2C and WC, respectively. Other minor products were also identified. A pyrophoric material, which was probably metallic sodium or sodium carbonyl, was produced in many of the reactions. A few reactions carried out with NaOH gave the same products as Na_2CO_3. (auth) (UK)

34265 USE OF IONIC BOMBARDMENT TO INCREASE THE CONDUCTIVITY OF METALLIZED THIN PLASTIC FILMS FOR MAKING SOURCE MOUNTS. Roy, J. C.; Turcotte, J. (Univ., Laval, Quebec). Can. J. Chem., 45: 1379-83(June 15, 1967).

A study was made on the conductivity of thin flexible collodion films metallized either with gold (99.95%) or with gold–18% palladium alloy and the results obtained were compared with the conductivity of VYNS (a poly(vinyl chloride)–acetate copolymer) films coated with the same metals. For both types of films the conductivity was better with the alloy, especially for VYNS. VYNS films coated with gold or the alloy showed better conductivity than collodion coated with either metal. However, ionic bombardment of the collodion films prior to metal coating considerably improved their conductivity, especially with the Au–18% Pd alloy. For this alloy the conductivity went up by a factor of 100 to 1,000,000, and then became better than that obtained with VYNS. Although ionic bombardment had a less pronounced effect on the VYNS, an improvement in conductivity was still observed. (auth)

34266 CATALYTIC DECOMPOSITION OF METHANOL OVER NICKEL WIRE. Yasumori, Iwao; Nakamura, Tetsuro; Miyazaki, Eizo (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap., 40: 1372-6(June 1967).

The kinetic studies of the decomposition of methanol were undertaken under pressures up to 20 mmHg and at temperatures between 300 and 430°C. The initial rate (r_0) of decomposition that turns methanol into carbon monoxide and hydrogen is expressed by the equation, $r_0 = aP_m/(1 + b\sqrt{P_m})^2$ where P_m is the initial pressure of methanol and where a and b are constants. The addition of carbon monoxide to the reactant was found to depress the rate of reaction, while a slight promotion was observed on the addition of hydrogen to the system. When the kinetics of the decomposition of formaldehyde, which was regarded as the intermediate product in the methanol decomposition, was studied, it was found that formaldehyde decomposed to carbon monoxide and hydrogen, and that the rate was much larger than that of methanol decomposition. On the basis of these results and the exchange reaction of methanol with deuterium, the processes of methanol decomposition were discussed in detail and a possible mechanism of reaction was proposed in which the surface reaction between the adsorbed methoxy radical and the hydrogen atom, both produced by the dissociative adsorption of methanol, is the rate-determining step of the reaction. (auth)

34267 THIAZOLYLAZO DYESTUFFS AS COORDINATING LIGANDS. PART I. THE STABILITY CONSTANTS FOR 4-(2-THIAZOLYLAZO)-RESORCINOL AND RELATED COMPOUNDS. Nickless, G.; Pollard, F. H.; Samuelson, T. J. (Bristol Univ., Eng.). Anal. Chim. Acta, 39: 37-46(Sept. 1967).

The complex forming properties of the thiazole azo dyestuffs and related compounds were studied in order to try to ascertain the role of importance of the donor atoms present in thiazolylazo-resorcinol. Potentiometric titrations were employed for these determinations, although in many cases meaningful stability constants could not be obtained because of reagent instability or insolubility of the complexes formed on chelation. (auth)

34268 MECHANISMS OF REACTIONS OF THIOLSULFINATES (SULFENIC ANHYDRIDES). I. THE THIOLSULFINATE-

SULFINIC ACID REACTION. Kice, John L.; Venier, Clifford G.; Heasley, Leslie (Oregon State Univ., Corvallis). J. Amer. Chem. Soc., 89: 3557-65(July 5, 1967).

In aqueous acetic acid containing some sulfuric acid, aryl thiolsulfinates (sulfenic anhydrides) react with aromatic sulfinic acids considerably more rapidly than they undergo disproportionation to thiolsulfonate and disulfide. The mechanism of this thiolsulfinate–sulfinic acid reaction was investigated. The reaction is subject to rather dramatic catalysis by added alkyl or aryl sulfides. Study of the dependence of the rate of the sulfide–catalyzed reaction on various reaction variables shows that the mechanism involves a rate-determining nucleophilic attack by the sulfide on the protonated thiolsulfinate. The catalyzed reaction is thus similar to several other recently studied S–S bond scissions in requiring both nucleophilic and electrophilic assistance. The non-sulfide-catalyzed thiolsulfinate–sulfinic acid reaction exhibits a different dependence on the acidity of the medium and a different solvent isotope effect than the sulfide-catalyzed process. This coupled with the variation of rate with sulfinic acid structure, suggests that its mechanism involves a general base-catalyzed attack of the sulfinic acid on the protonated thiolsulfinate. (auth)

34269 NUCLEOPHILIC DISPLACEMENTS AT SULFUR. III. THE EXCHANGE OF ^{18}O BETWEEN SODIUM THIOSULFATE-^{18}O AND WATER. Pryor, William A.; Tonellato, Umberto (Louisiana State Univ., Baton Rouge). J. Amer. Chem. Soc., 89: 3379-86(July 5, 1967).

The exchange of ^{18}O between water and thiosulfate ions was measured in aqueous solutions at 60 to 100°C and pH from 5.3 to 6.5. The rate is first order in thiosulfate ions and first order in protons; is catalyzed by the proton specifically; does not show general acid catalysis; and does not show catalysis by chloride ions. The slope of the graph of log k vs $\mu^{1/2}$ is zero both in regions of high and low ionic strength. The exchange is faster in D_2O than in normal water, with k_{H_2O}/k_{D_2O} being equal to 0.63. The temperature parameters are E_a = 13.4 kcal/mole, log A = 9.9, and $\Delta S^{\ddagger}$ = –16 eu at 80°C. A mechanism for the exchange is proposed in which a water molecule attacks the inner sulfur of $HO-SO_2-S^-$ in an SN2 reaction. This mechanism is analogous to the A-2 hydrolysis of esters and is supported by the solvent isotope effect and by the negative value of $\Delta S^{\ddagger}$. This ^{18}O exchange of thiosulfate is compared to two other reactions to which it has superficial similarity; they are a disproportionation to sulfide and sulfate and ^{35}S exchange with bisulfide ion. In the ^{35}S exchange reaction, HS^- attacks thiosulfate at the outer sulfur whereas in the ^{18}O exchange and the disproportionation water attacks at the inner sulfur. In comparing the latter two processes, the displacement of HS^- from $HS-SO_2-O^-$ by water occurs with an activation energy which is 40 kcal/mole less than the displacement of HO^- from $HO-SO_2-S^-$ by the same nucleophile. These remarkable differences between these reactions are discussed and rationalized. The exchange of ^{18}O in the sulfur oxyanions probably occurs in the order thiosulfate > sulfite > sulfate, and reasons for this are proposed. (auth)

34270 DEPENDENCE UPON pH OF THE RATE OF DEUTERIUM EXCHANGE BETWEEN HYDROGEN AND WATER ON NICKEL CATALYST. Enyo, Michio; Matsushima, Tatsuo (Hokkaido Univ., Sapporo). J. Res. Inst. Catal., Hokkaido Univ., 14: 248-56(Mar. 1967).

Experimental studies were carried out on the dependence on solution pH 7 to 13 of the rate of deuterium exchange between hydrogen and water on nickel catalyst, both in presence and absence of supporting electrolyte. The exchange rate was found to be independent of the solution pH throughout the systems chosen: KOH, KOH + KCl, NaOH + $NaClO_4$ and KOH + K_2SO_4. The facts strongly support the theory that the hydrogen electrode reaction on nickel in alkaline solution obeys the catalytic mechanism. (auth)

34271 DETERMINATION OF THE EQUILIBRIUM CONSTANT OF ISOTOPE EXCHANGE BY NMR MEASUREMENTS. Neszmelyi, Andras; Simonyi, Miklos; Tudos, Ferenc (Central Inst. of Chemical Research, Budapest). Magy. Kem. Foly., 73: 155-7 (Apr. 1967). (In Hungarian).

Suitable concentrations of the system water–hydroquinone–acetone afforded NMR spectra by which the water and phenol contents of the mixture are measurable simultaneously. In a solution of hydroquinone and heavy water, equilibrium was rapidly attained at room temperature. On the basis of two measured equilibrium concentrations, the conversion, and from this the concentrations of the other components, can be determined. The equilibrium constant found (K = 0.90 ± 0.11) was in excellent agreement with the partition ratio of phenol determined previously. (auth)

34272 ANALYTICAL CHEMISTRY OF ACTINIUM. Kirby, H. W. (Mound Lab., Miamisburg, Ohio). Progr. Nucl. Energy, Ser. IX, 8: Pt. 1, 89-139(1967).

The subject is reviewed under the following headings: introduction; occurrence and synthesis of actinium; general chemistry of actinium (the actinide hypothesis, metallic actinium, actinium amalgam, soluble and insoluble compounds, coprecipitation and adsorption, complexation); solvent extraction (thenoyltrifluoroacetone, tributyl phosphate, bis(2-ethylhexyl) ester of phosphoric acid, bis(octylphenyl) ester of phosphoric acid); chromatography (cation exchange, anion exchange, paper electrophoresis); detection, identification and quantification (^{227}Ac, ^{228}Ac, ^{225}Ac); and sample dissolution. (120 references.) (UK)

34273 THE AMMONOLYSIS OF URANIUM HALIDES. II. THE REACTIONS OF UCl_3 AND UBr_3 WITH NH_3. Burk, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Z. Anorg. Allg. Chem., 350: 62-9(Mar. 1967). (In German).

The reaction of dry ammonia with UCl_3 and UBr_3 was investigated between 20 and 750°C. The reaction products were the ammoniates of the halides, uranium imido or nitridohalides and uranium nitride. The formation of amidohalides during the ammonolysis is improbable, but the existence of free uranium(III) halide was proved at medium temperatures. (auth)

34274 X-RADIOGRAPHIC STUDIES OF ISOTOPE EFFECTS ON CRYSTALS OF SIMPLE AND COMPLEX HYDRIDES. Subrtova, Vera (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Z. Anorg. Allg. Chem., 350: 211-13(Mar. 1967). (In German).

Substitution of D for H in simple and complex hydrides results in a decrease of the lattice constants. This was proved for NaH–NaD, $NaBH_4-NaBD_4$, $NaAlH_4-NaAlD_4$, and $LiBH_4-LiBD_4$. (auth)

34275 HEAVY IRON HYDROXIDE, α–FeOOD. Wolski, Wlodzimierz; Burewicz, Andrzej; Skrzypczak, Josef (Univ., Poznan, Poland). Z. Anorg. Allg. Chem., 351: 63-7(Apr. 1967). (In German).

Deutero iron(III) oxide hydroxide (ferric acid) of the goethite type, α–FeOOD, was prepared by $Fe(OD)_3 \rightarrow$ α–FeOOD conversion, which was investigated by x-ray, thermogravimetric, differential thermal analysis (DTA), and electron-microscope techniques. The endothermic dehydration DTA peak of α–FeOOD occurred at a 10°C higher temperature than that of α–FeOOH (analogously prepared), the exothermic peak corresponding to crystallization to Fe_2O_3 lay 5°C higher for α–FeOOD. (auth)

34276 ANALYTICAL CHEMISTRY OF PROTACTINIUM. Brown, D. (Atomic Energy Research Establishment, Harwell, Eng.); Maddock, A. G. Progr. Nucl. Energy, Ser. IX, 8: Pt. 1, 1-47(1967). (TID-23282).

The subject is reviewed under the following headings: introduction; general chemistry (Pa(V), Pa(IV)); separation procedures (tracer control, ion exchange, paper chromatography and electrophoresis, solvent extraction, extraction of ion pairs, extraction of solvates, extraction of chelate complexes); recommended separation procedures (separation from complex mixtures, target separations, geochronological procedures); classical analysis (volumetric or polarographic determination, gravimetric determination, spectrophotometric procedures, emission spectroscopy); and radioactive assay (activation analysis, urine and whole body determinations). (217 references.) (UK)

34277 SOLUTION CHEMISTRY AT 1000°. Gruen, D. M. Argonne Nat. Lab. Rev., 24-32(Jan.-Apr. 1967).

The results of studies on fused salt chemistry using high temperature absorption spectrophotometry are reviewed. Topics treated are: some spectroscopic properties of fused salt solvents and transition metal ions; oxidation states of metal ions; complex ions in fused salts; octahedral-tetrahedral equilibria of 3d ions in chloride melts; and, fused salt and concentrated electrolyte systems. (J.G.B.)

34278 ISOTOPIC EQUILIBRIUM IN THE HYDROGEN–AMMONIA SYSTEM. Barb, D.; Moraru, Nicoleta (Inst. of Atomic Physics, Cluj). Stud. Cercet. Fiz., 19: 131-9(1967). (In Rumanian).

The complex isotopic equilibrium established as a result of reversible isotopic exchange reactions involving deuterated molecular species of hydrogen, H_2, HD, D_2, and ammonia, NH_3, NH_2D, ND_2H, and ND_3, in the presence of a catalyst, involves theoretically 12 equations of the $AX + BX^* \rightleftharpoons AX^* + BX$ type but only 5 of them are considered truly independent. The equilibrium constant, expressed on the basis of the partition functions of the reactant molecules, was calculated from literature data for temperatures of –50, 0, 25, and 100°C; from them, the equilibrium curve, illustrating the distribution of deuterium between the hydrogen and deuterium phases was constructed. It was concluded that the deuterium content in the 2 phases depends primarily on the temperature of the catalysts; for a given deuterium content, the distribution of the molecular species in each of the phases is only slightly affected

by the temperature. The results are similar to those obtained earlier for the hydrogen–water vapor system. (TTT)

34279 DETERMINATION OF ^{241}Am IN PURE PLUTONIUM USING EXTRACTION WITH TRIOCTYLPHOSPHINE OXIDE AND GAMMA COUNTING. Bubernak, Joseph; Lew, Marion S.; Matlack, George M. (Los Alamos Scientific Lab., N. Mex.). Anal. Chem., 39: 1167-9(Aug. 1967). (LA-DC-8561).

Extraction of plutonium and uranium using trioctylphosphine oxide (TOPO) in nitric acid permitted ^{241}Am to be determined in the aqueous phase. Results of this extraction method are compared with $\alpha-\gamma$ counting method. In almost all cases the $\alpha-\gamma$ method yielded higher results, which were attributed to ^{237}U, although the differences were usually small. The TOPO extraction method is recommended for ranges of Am down to 0.2 ppM. (P.C.S.)

34280 STUDY OF THE HYDROLYSIS AND EXCHANGE REACTIONS OF VARIOUS AMINE BORANES. Landorf, Martha Anne Hodges. Lafayette, Ind., Purdue Univ., 1966. 107p.

Thesis.

The rates of the hydrolysis reaction and the exchange reaction of several amine boranes were determined in order to learn more about the chemistry of these compounds. The hydrolysis reaction was found to be second order, first order in acid, and first order in amine borane at low pH in aqueous media, and at about 25°C. Study of the hydrolysis of several substituted pyridine boranes showed that the reaction was not very sensitive to steric effects but that the reaction was very sensitive to electronic effects (a plot of the second order rate constant versus a Hammett sigma constant showed a rho equal to −7.9). The pyridine boranes hydrolyzed much faster than other tertiary amine boranes. The mechanism suggested to explain these data is that the reaction proceeds via a hydride abstraction to an unstable intermediate, which, in the case of the pyridine boranes, can be stabilized by the π electron cloud. The rates of hydrolysis were determined by following the increase of amine absorbance in the ultraviolet or, iodimetrically, by taking aliquots from the reaction solution and oxidizing the borane with a known solution of potassium iodate and titrating with sodium thiosulfate. The exchange reaction was also found to be second order, first order in acid and first order in amine borane. The reaction proceeds by a stepwise mechanism, replacing one boron hydrogen at a time. This was determined in the infrared and by use of a mass spectrometer. The reaction was not very sensitive to steric effects and was greatly enhanced by electron donating groups on the pyridine ring. The rate of exchange of pyridine borane was comparable with that of the aliphatic amine boranes, trimethylamine borane and morpholine borane. The rate of the exchange reaction of trimethylamine borane was followed in the infrared. The rate constants for all other compounds were determined by means of an equation relating the rate constant for the exchange reaction, k_E, to the rate constant for the hydrolysis reaction, k_H, and the ratio R, of the gases HD/D_2 produced when the amine borane was placed in acidic D_2O: $2Rk_E^2 + (5k_H R - 6k_H)k_E^2 + (3k_H^2 - 15k_H^2)k_E - 9k_H^3 = 0$. A displacement mechanism involving either a five center "s_n2 type" transition state or a transition state with two, B-H-N and B-D-N, bridge bonds was suggested. (Disser. Abstr.)

34281 DEUTERIUM EFFECTS ON THE SOLVOLYSIS RATES OF SOME PROPARGYL AND ALLENYL CHLORIDES. Kriz, George Stanley Jr. Bloomington, Ind., Indiana Univ., 1966. 64p.

Thesis.

4-Chloro-4-methyl-2-pentyne, its -1,1,1-d_3, and -4-methyl-d_3-5, 5,5-d_3 analogs were synthesized and their solvolysis rates measured at 25°C in several aqueous solvent mixtures. The rate retardation due to deuterium in 4-chloro-4-methyl-2-pentyne-1,1, 1-d_3 is an example of transmission of an isotope effect across an unsaturated linkage. The isotope effect rate ratio, k_H/k_D, for this compound is about 1.09 and is not appreciably solvent dependent. 4-Chlor-4-methyl-d_3-2-pentyne-5,5,5-d_3 showed an isotope effect, k_H/k_D, of 1.655. The contribution to the rate effect of β-deuterium substitution from relief of steric strain was estimated to be at most only a small fraction of the total observed. The products of the solvolysis reaction were studied and were found to be those expected for a unimolecular solvolysis. Attempts were made to synthesize 2-chloro-4-methyl-2,3-pentadiene and its deuterated analogs from the corresponding acetylenic chlorides. These attempts were unsuccessful. Attempts were also made to synthesize 2-chloro-2,6,6-trimethyl-3-heptyne and its deuterated analogs. These attempts were also unsuccessful, although a suggestion is made for a sequence of reactions that would be expected to be successful. The conformational dependence of deuterium isotope effects was used to study the stereochemistry of a reaction. The reaction is a reduction of cyclic enol acetates to the corresponding saturated alcohols. The enol acetate is treated with lithium aluminum hydride, followed by hydrolysis with water. By using this method to synthesize trans-4-t-butylcyclohexyl brosylate-2-d and solvolyzing it, thus determining its isotope effect, and comparing this isotope effect with known isotope effects for conformationally pure compounds, the relative amounts of axial and equatorial deuterium atoms could be determined. In this fashion, it was found that 72% of the deuteriums in the 2-position were axial, thus showing that the reaction was largely, but not wholly, stereospecific. The kinetic experiments were accomplished using a sophisticated method of conductometric rate measurements and data treatment. (Disser. Abstr.)

34282 SYNTHESIS OF SOME AMINO ACID DERIVATIVES AS POTENTIAL ANTIRADIATION COMPOUNDS. Holtz, Carl Frederick. Troy, N. Y., Rensselaer Polytechnic Inst., 1966. 110p.

Thesis.

Amino acid disulfides, amino acid dithiols, thiazolidines, and their polymers were prepared for screening as possible antiradiation compounds. The synthesis of 4-amino-o-dithiane-4-carboxylic acid hydrochloride was pursued because of interest in the radioprotective ability of strained-ring cyclic disulfides and because of the similarity of its precursor, 2-amino-2-mercaptomethyl-4-mercaptobutyric acid γ-(thio lactone) hydrochloride to known radioprotectives. Compounds prepared in this reaction sequence included 1,4-bis(benzylthio)-2-butanone, 5-(β-benzylthioethyl)-5-benzylthiomethylhydantoin, 2-(β-benzylthioethyl)-2-benzylthiomethylglycine in addition to the two aforementioned compounds. Derivatives of 1,2-dithia-5-azepane hydrochloride and thiomorpholine hydrochloride were prepared in an attempt to use these compounds as models for solubilization and polymerization studies. 4-Aminothiomorpholine hydrochloride, N-nitroso-1,2-dithia-5-azepane and N-nitroso-thiomorpholine were prepared in connection with the attempted preparation of 5-amino-1,2-dithia-5-azepane hydrochloride. Oxidation of 1,2-dithia-5-azepane hydrochloride with hydrogen peroxide gave 1, 1-dioxy-1,2-dithia-5-azepane hydrochloride. The solubilization of 2-(n-decylamino)ethanethiol and 2-(n-octylamino)ethanethiol was accomplished by reaction with formaldehyde and then hydrogen chloride to yield 3-(n-decyl)thiazolidine hydrochloride and 3-(n-octyl)thiazolidine hydrochloride. Reaction of the thiols or the thiazolidines with a large excess of sodium bisulfite gave 2-(n-decylamino)ethanethiosulfuric acid and 2-(n-octylamino) ethanethiosulfuric acid. The thiazolidines 4-carboxythiazolidino [3,4-c]thiazolidinium chloride and 4-carboxythiazolidino [3,4-c] thiazanium chloride were also prepared by the reaction of the corresponding amino dithiols with formaldehyde. The thioketal, 5-amino-1,3-dithiane-5-carboxylic acid was obtained by the reaction of 2-(mercaptomethyl)-cysteine hydrochloride with formaldehyde. Polydiethyleneaminedisulfide hydrochloride was prepared by the cyanide ion catalyzed polymerization of 1, 2-dithia-5-azepane, but attempts to prepare polymers of 1,2-dithia-5-azepane-5-acetic acid or its derivatives, 4-amino-1, 2-dithiolane-4-carboxylic acid and 2-amino-2-mercaptomethyl-4-mercaptobutyric acid γ-(thio lactone) hydrochloride failed. (Disser. Abstr.)

34283 INTERMOLECULAR FORCES, THE VIBRATIONAL SPECTRUM AND CRYSTAL STRUCTURE OF HYDROGEN FLUORIDE. Kittelberger, J. Stephen. Princeton, N. J., Princeton Univ., 1966. 236p.

Thesis.

The infrared spectra of pure crystalline HF and DF, as well as several mixed isotopic crystals, were reexamined and extended over the region 20 to 4000 cm^{-1} using spectrometric and interferometric techniques. The Raman scattering from polycrystalline HF and DF was studied for the first time over the region 100 to 4000 cm^{-1}. Four lines were observed in the internal stretching region of the HF spectrum in both infrared and Raman, where only two are predicted by group theory. The infrared spectrum of DF, however, was also found to contain four lines in this region where only two were previously observed. On the basis of the line spacings here, together with the direct observation of a band near 200 cm^{-1} in the far-infrared spectrum of both HF and DF, the extra two lines in the internal region can be assigned as combination bands. The same combination appears in the infrared spectrum of HF molecules isolated in a DF lattice, and vice versa. The two bands observed in the far-infrared spectrum near 360 cm^{-1} and 200 cm^{-1} in both HF and DF can be assigned as pseudo-translations from their frequency shifts on deuteration. Correlation of these frequencies with those observed in HCl, HBr, and HI permits an unambiguous assignment of these bands. The relationship between the lattice frequencies observed here and those obtained from the inelastic neutron scattering spectrum is discussed. The dynamic polarizability tensor for an HF unit cell was derived. A complicated series of bands is observed in the librational region of the infrared spectrum. It is shown that one of these, at 792 cm^{-1} in

HF, can be nearly extinguished by preparation of the crystalline film near its melting point. A strong line at 550 cm^{-1} in HF can be assigned as an out-of-plane libration on the basis of intensity predictions and preliminary force constant calculations. The spectra are inconsistent with structures whose unit cells contain more than four molecules. Each Raman line is within experimental error coincident with an infrared band, which suggests that the mutual exclusion rule is not operative here. A theoretical study of the electrostatic contribution to the cohesive energy is carried out for a number of possible structures using dipole and quadrupole forces, as well as a point-charge model for the intermolecular potential. It was possible to include a calculation of the electrostatic energy of the disordered structure by using a Monte Carlo technique. The results indicated that only non-polar structures are possible, but that all structures that have no ferroelectric properties are close in electrostatic energy. In particular, the disordered structure had an excellent chance of being stable with respect to the several ordered structures. The total electric dipole moment of a crystalline HF molecule was found, from these calculations, to be 2.4 to 2.6 debyes. A theoretical calculation of the coupling force constants for the internal vibration was carried out for several structures using dipole, quadrupole, induced dipole, and coulombic contributions to the intermolecular potential. The calculations indicate that no ordered structure can give rise to the pattern of lines observed in the infrared and Raman spectra. There is, therefore, a strong suggestion that the crystal structure of HF is D_{2h}^{17}, the disordered structure in which the sense of the hydrogen-bonded chains is random along the Y-axis of the crystal. (Disser. Abstr.)

34284 ATLAS SPEKTRAL'NYKH LINII DLYA ANALIZA RUD I MINERALOV NA DIFRAKTSIONNOM SPEKTROGRAFE. (Collection of Spectral Lines for Ore and Mineral Analyses on Diffraction Spectrograph). Kolenko, L. I. Moscow, Izdatel'stvo Nauka, 1967. 124p.

Experimental data for spectral analysis of ores and minerals of rare earths, W, Mo, Nb, Ta, U, Th, and other elements with multilinear spectra are presented. The atlas may be used for interpreting spectra from diffraction spectrometers with 3.4 Å/mm dispersion and consists of iron-arc spectra with sensitivity lines for 71 elements at 2100 to 7000 Å range and tables of analytical lines distributed according to increasing wavelength and sensitivity of each element. (R.V.J.)

34285 IMPROVEMENTS IN OR RELATING TO CHEMICAL REACTORS. Matricon, Marcel (to Commissariat a l'Energie Atomique). British Patent 1,072,722. June 21, 1967. Priority date Oct. 22, 1962, France.

A chemical reactor is described for effecting chemical exchange between two liquid phases of different densities. The reactor includes a stationary column for effecting chemical exchange between the two liquids by countercurrent circulation. Electrolysis means are located in a number of annular chambers in which the heavy phase can spread out in sheet-like form. The heavy phase serves as the cathode. A number of members contacting the light phase serve as the anode, and the light phase serves as the electrolyte. Baffle members are provided within the annular chambers to impart a quiescent state to the heavy phase, and withdrawal orifices are provided in the annular chambers adjacent to the baffle members for the removal of the gases produced in exchange column and for gases produced by electrolysis. (B.L.M.)

34286 PALLADIUM–HYDROGEN SYSTEM. Lewis, F. A. London, Academic Press, 1967. 178p. 45s.

A review is presented under the main headings: general introduction; thermodynamic factors; changes of shape and mechanical and elastic properties of palladium resulting from absorption and desorption of hydrogen; relationships between hydrogen content and electrical resistance; chemical stability of hydrided palladium; absorption of hydrogen by alloys of palladium; diffusion of hydrogen through palladium and alloys; adsorption of deuterium by palladium and alloys (separation of hydrogen isotopes); investigations of changes of lattice structure and of other physical and electrical properties as functions of hydrogen and deuterium contents; and theoretical models for the Pd/H and related systems. (UK)

34287 THE INDUSTRIAL CHEMISTRY OF THE LANTHANONS, YTTRIUM, THORIUM, AND URANIUM. Callow, R. J. New York, Pergamon Press, 1967. 253p. $9.50.

The industrial chemistry of the lanthanons, including yttrium and thorium, and uranium is described. Some topics discussed are: solution chemistry of the elements; principal sources; ore treatment processes; purification of initial products; preparation of commercial products and their uses; separation of individual lanthanons; and legal implications of radioactivity. (D.H.M.)

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Refer also to abstracts 35224, 35225, 35442, and 35701.

34288 (AE–283) NUCLEAR CHEMISTRY. Progress Report, 1966. Carleson, G. (Aktiebolaget Atomenergi, Stockholm (Sweden)). May 1967. 29p. Dep. SWED.

A systematic investigation of properties, such as solubilities and vapour pressures, for a series of hydrated and unhydrated salts in light and heavy water is being carried out from 60°C down to eutectic temperatures. Phase diagrams have been constructed and isotopic hydrogen–deuterium effects determined. By means of pulse radiolysis equipment, the spectrum of the hydroxyl radical has been identified and studied in carefully purified water, saturated with N_2O or argon. A spectrum similar to that of the solvated electron has been observed during irradiation of ice crystals with good transparency. As part of a project to develop methods for the manufacture of wood-polymer combinations of industrial interest, properties such as grafting of vinyl polymers onto swollen and native microstructural elements of various wood species, copolymerization of solvent and monomer, and trapping of solvent inside the polymer network have been studied and related to physical properties of the new material, among others water absorption, dimensional stability, and hardness. Inorganic ion exchangers of phosphate type are fairly stable to radiation and elevated temperature and might therefore be applied for the direct purification of the circulating cooling water in a power reactor. The sorption behavior and affinity of zirconium and iron(III) phosphate gels, prepared in various ways, to some of the more important corrosion products have been investigated in nitrate solutions at room temperature; the experiments are planned to be continued at higher temperatures. (auth)

34289 (CEA-R-3232) CELLULE BLINDEE PETRUS POUR LA PRODUCTION ET L'ETUDE DU CALIFORNIUM 252. (The Protective Cell PETRUS for the Production of ^{252}Cf). Sontag, Rene; Berger, Rene (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr. 1967. 43p. (In French). Dep.

The alpha, beta, gamma neutron cell is described, which is devoted to transplutonium element production and study. It is located at the CEN in Fontenay-aux-Roses (France). The 4-ft ordinary concrete shielding made of stacked blocks allows manipulation of radioactive sources as high as 1000 curies of 1 MeV gamma rays and with a fast-neutron flux of 10^9 n cm^{-2} s^{-1}. The airtight alpha containment box is equipped with two transfer systems: one consists of a parallelepiped-shaped airtight box located in a turntable; the other uses standard cylindrical containers made of polyethylene. The general equipment and the main setting up are also described. (auth)

34290 RADIATION-CATALYTIC TRANSFORMATION OF METHANOL IN THE ADSORPTION LAYER ON SILICA GEL SAMPLES VARYING IN SPECIFIC SURFACE AREA. Vladimirova, V. I.; Zhabrova, G. M.; Kadenatsi, B. M.; Krivenkova, P. G.; Neimark, I. E.; Chertov, V. M.; Sheinfain, R. Yu. (Inst. of Chemical Physics, Moscow. Inst. of Physical Chemistry, Kiev). Dokl. Akad. Nauk SSSR, 172: 629-32(Jan. 21, 1967). (In Russian).

Insulators, specifically silicon dioxide in the form of silica gel, exhibit the highest radiation-catalytic activity when ionizing radiation and solids with varying electron structure act simultaneously. The role played in the energy transfer by the specific surface and the bulk of the solid was investigated, using several specimens of silica gel prepared by various heat treatments of the hydrogel. The specific surface of the gels was determined by the Brunauer–Emmett–Teller method. The radiation-induced transformation of the methanol was achieved by exposure of the layer adsorbed on the gel to ^{60}Co source at room temperature. The surface was covered to about 50% in one series of experiments; in that case the amount adsorbed depended on the specific surface. In the second series, the same amount of methanol, about 0.17 mmol/g, was used; this did not exceed the amount required for forming a monomolecular layer even for the sample with the lowest specific surface (20 m^2/g). Determination of the radiation-chemical yield of the products, formaldehyde and ethylene glycol, pointed out the strong influence of the solid which absorbs the radiation energy. Part of the energy may be transmitted to the adsorbed molecules. No correlation was found between the yield and the grain size of the gel and the specific surface. The results agree with the electron mechanism of energy transfer from the solid to the adsorbed layer. (TTT)

34291 DIFFUSION THEORY OF THE POST-IRRADIATION OXIDATION OF POLYETHYLENE. Boehm, Georg G. A. (Northwestern Univ., Evanston, Ill.). J. Polym. Sci., Part A-2, 5: 639-52(July 1967). (COO-1088-22).

The primary reaction of oxygen with irradiated polyethylene was studied by observing the rapid disappearance of the ultraviolet absorption bands at 258 and 285 mμ, bands attributed to the allyl and dienyl free radicals. A mathematical theory based on diffusion equations was developed enabling a quantitative estimate of the total initial free radical concentration to be made. From the shape of the free-radical decay curve it can be concluded that the initial oxygen free radical reactions occur about three times as frequently in the amorphous regions as in the crystalline. (auth)

34292 STABILIZATION OF HYDRATED ELECTRONS IN IRRADIATED FROZEN SUGAR SOLUTIONS. Elliott, W. R. (Massachusetts General Hospital, Boston). Science, 157: 558-9 (Aug. 4, 1967).

Yields of free radicals in irradiated aqueous solutions of saccharides at 77°K are larger and qualitatively different from those observed in the components alone. In addition, a blue color results only with the solution. The mechanism proposed to explain the observations is the stabilization of hydrated electrons by the solute. (auth)

34293 INFLUENCE OF ADDITION OF OLEFINS ON THE ALTERNATING COPOLYMERIZATION OF CARBON MONOXIDE AND ETHYLENIMINE BY AZOBISISOBUTYRONITRILE OR BY γ-RAY IRRADIATION. Kagiya, Tsutomu; Maruta, Isao; Ichida, Taizo; Narisawa, Shizuo; Fukui, Kenichi (Kyoto Univ.). J. Polym. Sci., Part A-1, 5: 1645-58(July 1967).

The alternating copolymerization of carbon monoxide and ethylenimine to give poly-β-alanine could be initiated by γ-irradiation but hardly by α,α′-azobisisobutyronitrile (AIBN). It was found that in the case of the addition of olefin, this system could be copolymerized even by AIBN and that, in the γ-ray copolymerization of carbon monoxide and ethylenimine, the addition of olefin brought about an increase in the copolymer yield. No difference was observed between the nature of copolymers obtained by AIBN and those obtained by γ-irradiation, except in the system carbon monoxide–ethylenimine–ethylene. An increase in the amount of reacted olefin gave rise to an increase in copolymer yield. The melting points of the copolymers were in the range 295 to 335°C. The infrared spectra, x-ray diffraction diagrams, and NMR spectra of the copolymers were almost identical with that of poly-β-alanine obtained by the hydrogen-migration polymerization of acrylamide. Paper chromatographic analysis of the hydrolysis product of the copolymer showed the existence of β-alanine, ethylamine, and δ-aminovaleric acid homolog in the products. From these results, it was concluded that terpolymerization of carbon monoxide, ethylenimine, and olefin took place in the presence of AIBN or γ-irradiation, which gave a crystalline solid copolymer containing the units of nylon 3 and nylon 5. A mechanism of this copolymerization was proposed on the basis of these results. (auth)

34294 γ RADIOLYSIS OF LIQUID CARBON MONOXIDE AT −196°C. Buschmann, H. W.; Groth, W. (Univ., Bonn). Z. Naturforsch., 22a: 954-60(June 1967). (In German).

The radiation chemistry of liquid carbon monoxide at −196°C and mixtures of CO with various gases was investigated. In the γ radiolysis of pure CO, CO_2 was formed with $G(CO_2) = 0.18$. The addition of CH_4, C_2H_4, O_2, and NO led to the formation of C_3O_2 which was not observed in the γ radiolysis of pure CO. In the case of $CO-CH_4$ mixtures the following products were identified: C_2H_6, C_2H_2, H_2CO, H_2C_2O (Ketene), CO_2, and C_3O_2. Results of experiments with $CO-CH_4-{}^{13}CH_4$ and $CO-CH_4-CD_4$ mixtures and measurements of the dependence of $G(CO_2)$, $G(C_3O_2)$, $G(C_2H_2)$, and $G(C_2H_6)$ on the concentration of CH_4 showed that ethane is formed by energy transfer from CO to CH_4 or by reaction of CH_4 with excited CO and that C_3O_2 and C_2H_2 are formed by reaction of free carbon atoms which are formed in the presence of methane. (auth)

34295 ON THE CHANGES IN THE DIELECTRIC LOSS FACTOR AT 9.4GHz OF SOME SYNTHETIC SUBSTANCES FROM γ IRRADIATION. Sauerbrey, Helga; Suhr, Horst (Physikalisch-Technische Bundesanstalt Institut, Berlin). Kolloid Zh., 215: 127-30(1967). (In German).

Three polymers, polyvinylchloride (PVC), polymethylmethacrylate (PMMA), and a mixed polymer of methylmethacrylate and acrylonitrile (MMA-AN), were exposed to ^{60}Co γ radiation at dose rates of 2.6, 9.1, and 60 kR/hr to doses up to 10 MR. The dielectric loss factor was measured at 9400 Mcps as a function of the radiation dose for different temperatures and different surrounding atmospheres of the samples. With PMMA below 80°C the loss factor was strongly dependent on the atmosphere; it increased markedly above doses of 10^5R when irradiated in O_2 and decreased in N_2. With PVC it decreased after doses up to 1 MR, then increased at 22°C, but not at higher temperatures, above 1 MR in both O_2 and N_2. With MMA-AN, all doses above 10^4 R decreased the loss factor at all temperatures studied (20 to 100°C) in both atmospheres. The results showed that for temperatures higher than the glass transition temperature the dependence of the loss factor on irradiation was quite different from that at temperatures below the glass transition, as seen by the results with PMMA and PVC. (BBB)

34296 MECHANISM AND STOICHIOMETRY IN THE RADIOLYTIC OXIDATION OF PURINES AND AMINOPURINES IN AQUEOUS SOLUTION. Holian, J.; Garrison, W. M. (Univ. of California, Berkeley). Chem. Commun., No. 14, 676-7(1967). (UCRL-17575).

A quantitative study was made of reaction stoichiometry in the gamma radiolysis of oxygenated solutions of hypoxanthine and adenine, in which systems a second mode of oxidation at the 4,5 position was found, yielding oxalic acid and urea as characteristic products. Product formation was consistent with a formulation in which all reactions were initiated by OH attack at the 4,5 position. (UK)

34297 PULSE RADIOLYSIS OF AQUEOUS CNS^- SOLUTIONS AND THE RATES OF HYDROXYL-RADICAL REACTIONS. Baxendale, J. H.; Stott, D. A. (Univ. of Manchester, Eng.). Chem. Commun., No. 14, 699-700(1967).

Pulse radiolysis studies of thiocyanate solutions have shown that oxidation by OH gives a transient species which absorbs strongly in the visible region. This was presumed to be the radical $CNS^·$. In the present studies it was observed that at constant electron pulse intensity, such that the initial OH concentration is much smaller than the CNS^- concentration, the absorption produced began to decrease when the CNS^- concentration was sufficiently decreased. This observation is quantitatively explained if the absorption is due entirely to the species $(CNS)_2^-$, present in equilibrium with $CNS^·$. The kinetics of the relevant reactions are discussed. The system has been employed widely as a convenient method for obtaining reaction rates of OH radicals with solutes, using conditions in which the solutes compete with CNS^- for the radicals. In view of the present findings it would appear that the rate constants of OH reactions thus obtained are too small by a factor of about three. Also, it is possible that reactions of $CNS^·$ with the solute may complicate the system. Recent pulse radiolysis studies of aqueous nitrobenzene have confirmed these conclusions. (UK)

34298 AN ELECTRON SPIN RESONANCE STUDY OF 2-PYRIDYL IN γ-IRRADIATED PYRIDINE. Bower, Hilary J.; McRae, J. A.; Symons, M. C. R. (Univ. of Leicester, Eng.). Chem. Commun., No. 11, 542-3(1967).

The ESR spectrum of the radical formed by the γ irradiation of solid perdeuteropyridine consisted of an almost isotropic triplet with a hyperfine coupling of 30 gauss. Evidence is presented to suggest that the radical is not the pyridine cation, but its conjugate base, 2-pyridyl. At high gain, pairs of satellite lines were detected and analysed in terms of ^{13}C hyperfine interaction. The corresponding molecular parameters (c_σ^2 and c_π^2) were derived in the usual manner. The g-values and ^{14}N hyperfine coupling constants were determined by analysis of the Q-band spectrum of irradiated perdeuteropyridine and the ^{14}N atomic parameters were determined on the assumption that the measured values relate to the principal directions of the g-tensor. Attention is called to the link between the 2-pyridyl radical and the intermediate, benzyne, which has one less electron in the in-plane pseudo-π-system. The fact that the spin-density in 2-pyridyl radical is largely on carbon rather than nitrogen is to be expected for a three-electron system and follows closely the results obtained for nitrogen in diamond. The p/s ratio (λ^2) which is considerably greater than two on carbon and to a lesser extent on nitrogen corresponds to slight increases in the ∠C–C–N and ∠C–N–C bond angles. (D.H.M.)

34299 ACTION OF CHEMICAL SPECIES GENERATED FROM WATER RADIOLYSIS ON CARBON-CARBON DOUBLE BONDS. Le Roux, Yvonne; Noyer, Helene; Nofre, Claude (Service de Sante des Armees, Lyon). Bull. Soc. Chim. France, No. 6, 2003-11(June 1967). (In French).

The effect of pH, dose rate, O_2 and other chemical scavengers on the yield of the products formed during γ irradiation (^{60}Co) of aqueous solutions of some unsaturated, acyclic (fumaric, maleic and aconitic acids) or alicyclic (cyclohexene, 1-methyl cyclohexene) compounds, as well as the more specific action of the OH radical (generated by Fenton reaction or hydrogen peroxide photolysis) are studied. The action of chemical species generated from water radiolysis on carbon-carbon double bonds is not accompanied by cis-trans isomerization; hydroxylations are selectively trans only for the alicyclic derivatives, and only the H and OH species can attack the carbon-carbon double bonds to produce a carbon radical capable of reacting with e_{aq}^- or O_2. (auth)

34300 AGGRADATION OF FLUOROCARBONS FROM CF_4 AND CARBON IN NUCLEAR REACTOR RADIATION. Askew, William C.; Reed III, T. M. (Univ. of Florida, Gainesville). Nucl. Sci. Eng., 29: 143-5(July 1967).

Irradiation of pure perfluoroalkanes by neutrons and gamma rays produces mixtures of saturated perfluoroalkane molecules smaller than and larger than the parent molecule. The overall processes appear to involve carbon-carbon and carbon-fluorine bond rupture. Experiments indicated that it may be possible to stabilize fluorocarbons in irradiation fields by suspending carbon in fluorocarbon liquids that carry CF_4 in solution. (M.C.G.)

34301 THE AUTOXIDATION OF TOLUENE CATALYZED BY METAL IONS IN AQUEOUS SOLUTIONS. I. Suzuki, Nobutake; Hotta, Hiroshi (Japan Atomic Energy Research Inst., Takasaki). Bull. Chem. Soc. Jap., 40: 1361-7(June 1967).

The yield of benzaldehyde, which was the main product, depended on the kind of metal ions between 100 and 200°C. The yield was high in a ferrous sulfate solution, even at lower temperatures, while it was extremely low in a ferric sulfate solution, even above 180°C. The yield in a cupric sulfate solution was appreciable at 180°C only with γ-irradiation, while it was high near 200°C even without γ-irradiation. All the yields were a little higher with γ-irradiation than without. The rate-constant ratio of toluene to toluene-d_8 was about 1.4 for the benzaldehyde and benzyl alcohol produced by using Fenton's reagent at 70°C, respectively. It may be concluded from the experiments using the ^{18}O-enriched water that the oxygen of the benzaldehyde produced is transferred from the dissolved molecular oxygen, while that of benzyl alcohol is transferred partly from water. On the basis of these facts, a whole reaction scheme is proposed for the system. The difference between toluene and benzene is also discussed. (auth)

34302 ELECTRON SPIN RESONANCE SPECTRA OF AN IRRADIATED SINGLE CRYSTAL OF L-α-ALANINE AT 77°K. Minegishi, Atsuko; Shinozaki, Yoshiharu; Meshitsuka, Gisuke (Tokyo Metropolitan Isotope Research Center). Bull. Chem. Soc. Jap., 40: 1549(June 1967).

A single crystal of L-α-alanine was irradiated at 77°K by ^{60}Co γ rays and its x-band ESR spectra were observed at the same temperature. The crystal axes of L-α-alanine were determined by x-ray diffraction analysis. From the data, it was concluded that the α-proton is coplanar with the COO group and that the α-proton is bonded with the $O_{(1)}$ atom by a $2p\sigma$ bond. The unpaired electron densities on $C_{(1)}$ and $O_{(1)}$ were calculated and found to be 0.4 and 0.25, respectively. (P.C.S.)

34303 POLAROGRAPHIC STUDY OF REDUCTION OF HYDROXYANTHRAQUINONE DERIVATIVES BY ^{60}Co γ-IRRADIATION. Yasukouchi, Kazuo; Yamaguchi, Hiroko; Ono, Yukia; Urabe, Noriake (Kumamoto Univ., Japan). Nippon Kagaku Zasshi, 88: 626-9(June 1967). (In Japanese).

The kinetics of the reduction of hydroxyanthraquinone derivatives in dimethyl formamide (DMF) by γ-irradiation were investigated by the polarographic method, which was undertaken as one of the studies of the effect of hydroxy groups on the reduction of carbonyl groups and of the mechanism of the hydrogenation. Results of experiments showed that with an increase in total dose the height of two one-electron reduction waves decreased, and that the half-wave potential of the second reduction wave in the second step shifted to positive side. Reduction of hydroxyanthraquinone derivatives by γ-irradiation in DMF may be considered to proceed in two steps each involving the addition of one electron, as represented by the equation. Quinone $\xrightarrow{+2e}$ Anion Radical $\xrightarrow{+2e}$ Di-anion $\xrightarrow{+2H^+}$ Quinol. The first step involves the reversible addition of one electron, but the second step may not be entirely reversible because of hydrogenation in the electrode layer by the H· of DMF, which was produced by the γ-irradiation. The order of the first reduction step was zero, while the second step was of the zero or the first order. It was found that the formation of the abnormal wave due to the adsorption proceeded under the γ-irradiation. From the ratio of rate constants, it was possible to calculate the Hammett σ constants of some substituents; the ρ constants of the first and the second reduction steps were equal to 1.11. (auth)

34304 RADIATION-INDUCED CATIONIC POLYMERIZATION OF ISOBUTENE. Ueno, K.; Hayashi, K.; Okamura, S. (Kyoto Univ.). J. Polym. Sci., Part B, 5: 569-73(July 1967).

Radioinduced polymerization of isobutene dried by Na–K alloy and/or BaO was investigated. The range of polymerization was from liquid (–78°C) to glassy (–196°C) state. Rate of polymerization did not change with increasing temperature while the molecular weight decreased. Crystalline isobutene hardly polymerized at –196°C, but when 3-methylpentane was added as a glassy solvent at this temperature polymerization proceeded at a high rate. The glassy state polymerization was not sensitive to raising the temperature of the irradiated samples nor bleaching with uv and visible light at –196°C. Effects of NH_4^+ addition was negligible. Detailed kinetic studies are in progress. (P.C.S.)

34305 ELECTRON-EXCITED FLUORESCENCE OF SERPENTINES. Weber, J. N.; Greer, R. T.; Vand, V. (Pennsylvania State Univ., University Park). Planet. Space Sci., 15: 633-42(Apr. 1967).

Under 30- and 50-keV electron bombardment, natural serpentine specimens were found to display large variation in fluorescence characteristics within what appeared to be homogeneous, single-phase material. One hundred fifty-five sub-samples, 10 to 20 μ in diameter, were selected from thirty-three different serpentine specimens for examination by electron microprobe techniques, and relationships between fluorescence spectral data and elemental composition were sought. Higher concentrations of iron tend to suppress fluorescence and there was some evidence that manganese, and possibly chromium and titanium, were serving as activator ions, higher concentrations of which result in increased intensity and a shift to longer wavelengths. (auth)

34306 RADIOLYSIS OF ETHYL MERCAPTAN. Panchvidze, M. V.; Nanobashvili, E. M.; Beitrishvili, D. N.; Dapkviashvili, A. G. (Inst. of Inorganic Chemistry and Electrochemistry, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 45: 599-605 (Mar. 1967). (In Russian).

The radiolysis of ethyl mercaptan was studied and the basic regularities of its radiochemical conversion were established. The radiolysis products of ethanethiol were identified and the dependence of their yield on the nature of the solvents, temperature, and dose output was established. The RS radical in the ethyl and dodecyl mercaptan was characterized by the EPR method. A radical-chain mechanism was proposed for the radiolysis of the aliphatic thiols. (tr-auth)

34307 MODIFICATION OF WOOD BY RADIATION. I. THE IMPROVED POPLAR-STYRENE SYSTEM. Varga, Stefan (Slovak Technical Univ., Bratislava); Kosik, Martin; Katuscak, Svetozar. Jad. Energ., 13: 220-4(June 1967). (In Czech).

Radiation chemistry affords possibilities in impregnating natural macromolecular substances with synthetic polymers. The combination of poplar wood with styrene by means of gamma radiation is described. Styrene impregnation methods are described. The problems of the distribution of styrene and polystyrene formed under radiation in poplar wood, as well as some physical, chemico-physical, and mechanical properties of the products were investigated. (auth)

34308 SOME EXPERIENCES WITH THE STANDARDIZATION OF PURE β EMITTERS WITH A $4\pi\beta$ COUNTER. Klumpar, Josef; Majerova, Miroslava (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 13: 211-15(June 1967) (In Czech).

The suitability of various methods of preparing ^{35}S and ^{60}Co samples for a $4\pi\beta$ counter was tested by experimental determination of their self-absorption coefficients. Some advantages in the preparation of a thin and not dry layer of the standardized solution are considered. The theoretical computations of self-absorption of samples without uniform crystal dimensions are discussed. Results of standardization of a ^{35}S solution by the extrapolation method with the tracer ^{60}Co for coincidence measurements with different amounts of colloidal graphite and external filters on the samples and the results of the IAEA laboratory (Vienna) differed only by 1%. (auth)

34309 GAS-PHASE RADIOLYSIS OF PROPANE. Bone, Larry Irvin. Columbus, Ohio, Ohio State Univ., 1966. 71p. Thesis.

The Xe-sensitized radiolysis of propane was investigated in the presence and absence of very small amounts of various free radical and ionic interceptors. The products resulting from neutral excited molecule decompositions were estimated from published Xe resonance photolysis results, and ionic contributions were deduced from mixed isotope radiolysis. From a knowledge of radical disproportionation yields, a complete kinetic analysis was advanced. Ion titration methods demonstrated that neutralization of $C_3H_7^+$ leads quantitatively to the production of equivalent yields of isopropyl radicals and hydrogen atoms. A parallel investigation of the direct radiolysis of propane was conducted. The products resulting from neutral molecule dissociations were deduced from published data arising from experiments in which electric fields were applied during the course of the radiolysis. Ion titration methods demonstrated that neutralization of $C_3H_7^+$ leads quantitatively to the concurrent production of propyl radicals and hydrogen atoms. From the evidence presented a complete quantitative mechanism for the radioinduced decomposition of propane at very low conversion is advanced. The observed total dose dependence

of product yields is shown to result primarily from ion interception rather than from free radical scavenging processes, as was previously postulated. (Disser. Abstr.)

34310 CURING OF DRYING OIL IN WOOD FIBER WEBS BY GAMMA-IRRADIATION. Pasner, Laszlo. Vancouver, Univ. of British Columbia, 1966.

Thesis.

A technique is described for improving wood fiber web strength by copolymerization of a hydrocarbon drying oil (CTLA Polymer) within handsheets made from pure and admixed forms of high yield chemical (sulfite and sulfate) and groundwood fibers. Oil polymerization can be initiated successfully by prolonged thermal treatment at 145°C, as well as by the method of low-dosage γ irradiation. The treatment strengthens interfiber bonding. Evidence for copolymerization was sought through assessment of tensile and related strength data on variously treated standard handsheets. Effectiveness of the polymerization on pulp types investigated as initiated by heat and low dosage irradiation is strongly related to surface colloidal and basic physical and mechanical properties of the fibers. Maximum strength parameters were obtained with oil-saturated sulfite and groundwood handsheets following polymerization by thermal treatment. Copolymerization efficiency by irradiation, on the other hand, is estimated as 73% for sulfite, 65% for groundwood, and 50% for kraft handsheets. Effectiveness of oil polymerization by irradiation was found to be proportional to dosages up to 10^5 RAD. Limit of strength improvement was not set entirely by intrinsic fiber strength, but was also influenced by surface colloidal properties of the fibers. Blends made from chemical-groundwood fiber mixtures behaved more or less proportional to individual pulp strengths and extent of blending. Copolymerized sulfite-groundwood blends at equal proportions approximated the tensile strength of similar kraft papers suggesting better economy with kraft fibers when papers of limited strength are produced. All other strength parameters (elastic modulus, tensile strain, and tensile energy absorption) followed similar trends, or if different were of aid in explaining certain phenomena characteristic of treated fiber webs. The presence of graft copolymer could not be conclusively proven, since both the copolymer and oil homopolymer are insoluble in the usual organic solvents. A dual character of the oil polymer was demonstrated with glass filter paper and highly purified commercial cellulose fibers. Effectiveness of oil polymerization in highly lignified mechanical pulps was greatly depressed by mild sodium chlorite treatment, although the strength and bonding capacity of such fibers increased considerably. This was taken as direct evidence for the possibility of a lignin-CTLA polymer copolymer system. Site of chemical reaction was not described, although means for assessment of such information are suggested. The study proves the usefulness of γ-irradiation as energy source for the copolymerization of drying oils in handsheets as replacement for the prolonged thermal treatment hitherto used by the hardboard industry. Added advantages of radiation-processed copolymerized papers are less discoloration, especially with high lignin content pulps, and lower elastic modulus, a factor clearly objectionable for some paper uses. (Disser. Abstr.)

Radiochemistry

Refer also to abstract 34220.

34311 (NYO-1396-103) STUDIES IN NUCLEAR AND HOT-ATOM CHEMISTRY. Final Report. Koski, Walter S. (Johns Hopkins Univ., Baltimore, Md. Dept. of Chemistry). June 1967. Contract AT(30-1)-1396. 15p. Dep. CFSTI.

Research progress is reported on scintillation counting, nuclear chemistry, hot-atom chemistry, isotopic exchange, and radiation chemistry. (M.C.G.)

34312 (ORNL-TM-1838) EVALUATION OF A FOAMED NONRIGID PLASTIC AS A SEAL. Anderson, J. W. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 60p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee [Knoxville].

Use of a foamed nonrigid plastic as material to seal sleeve-type penetrations into cells maintained under negative pressures in radioactive processing was evaluated. Criteria were developed to define the desired material properties as related to the geometric design of the sleeve and plug, the fabrication and installation methods, and the operational environment. Flexible urethane foams and sponge or expanded cellular rubber products were selected for testing. Test equipment, procedures, and results are described. Closed-cell expanded neoprene seals may be satisfactory for installation in sleeve-type penetrations into radioactive hot cells at pressures up to 40 inches of water if the radiation exposure is substantially less than 10^8 roentgens. Further investigations are needed to determine the change in effectiveness of neoprene foam with age and radiation exposure. (auth)

34313 DIFFUSION OF TRITIUM IN QUARTZ AND FUSED SILICA. Matzke, Hj. (Technische Hochschule, Brunswick). Z. Naturforsch., 22a: 965-9(June 1967). (In German).

The release of tritium from single crystalline quartz and from fused silica was measured following 40-keV ion bombardment to a dose of 4×10^{11} ions/cm^2. The release can be explained by normal volume diffusion with $D_0 = 10^{1.41}$ cm^2 sec^{-1} for both materials and activation enthalpies of (42 ± 5) kcal/mole for quartz and (52 ± 5) kcal/mole for fused silica. Release from quartz is faster than release from fused silica. This latter diffusion process, however, is essentially slower than diffusion of hydrogen during permeation. Possible reasons for this discrepancy are the existence of radiation damage due to the ion bombardment or the chemical state of hydrogen which cause a different elementary process for mass transport. Hydrogen diffuses in molecular form during permeation whereas probably tritium atoms or ions will diffuse following ion bombardment. (auth)

Separation Processes

Refer also to abstracts 34287, 34288, 34343, 34429, and 35583.

34314 (BNWL-CC-126) FEASIBILITY STUDY OF A SINGLE VESSEL CONCEPT IN ^{233}U PROCESSING. Bond, W. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). June 21, 1965. Contract AT(45-1)-1830. 14p. Dep. CFSTI.

A vessel critically safe by geometry was fabricated in which the steps including filtration through conversion of UF_4 could be carried out. Initially unreasonable filtration rates were encountered, but these were readily overcome by improving the filtering properties of the precipitate and increasing the filtering area of the vessel. No major problems were encountered with either the calcination or the hydrogen reduction steps. The hydrofluorination of the resulting uranium dioxide readily converted it to the tetrafluoride with a conversion of 99%. A bomb reduction of the product gave a 100% yield to the metal. (auth)

34315 (CEA-R-3231) DECONTAMINATION DES EFFLUENTS DE TRAITEMENT DES COMBUSTIBLES IRRADIES PAR LE PARAPERIODATE DE PLOMB. (Decontamination of Irradiated Fuel Processing Waste Using Lead Paraperiodate). Auchapt, Jacqueline-Marguerite (Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule). Apr. 1967. 19p. (In French). Dep.

The process is designed to eliminate ruthenium. It consists of oxidation using para-periodic acid whose excess is precipitated in the form of a lead salt at a pH of 5 or 6. This process makes it possible to precipitate 80 to 98% of the ruthenium that is not removed by the conventional precipitation techniques that follow it. If the waste is a reducing agent, it is pre-oxidized using ozone or potassium permanganate. The process was developed at Marcoule in 1963 and since 1965 has been applied industrially; its cost is of the same order of magnitude as conventional processes and the results are satisfactory. (auth)

34316 (ISO-SA-39) PROGRESS IN CHLORIDE REMOVAL FROM PLUTONIUM-URANIUM NUCLEAR FUELS. Moore, E. L. (Isochem Inc., Richland, Wash.); Anderson, H. J. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1966]. Contract AT(45-1)-1851. 10p. (BNWL-SA-1221; CONF-670620-1). Dep. CFSTI.

From Northwest Regional Meeting of the American Chemical Society, Richland, Wash.

Small-scale batch runs were made in which a mixture of ammonium diuranate and plutonium hydroxide was precipitated from feed solutions containing various chloride concentrations. The chloride concentration was reduced from a maximum of 193 parts chloride per million parts uranium plus plutonium in the mixed nitrate feed solution to <10 parts chloride per million parts uranium plus plutonium in the dried filter cake for a decontamination factor of ca 20. The chloride concentration was reduced from a maximum of 200 parts chloride per million parts uranium plus plutonium in the dried filter cake to <10 parts chloride per million parts uranium plus plutonium in the pressed and sintered pellets for a decontamination factor of 20. (J.G.B.)

34317 (LA-3149) SEPARATION OF PLUTONIUM FROM PLATINUM BY COPRECIPITATION WITH FERRIC IRON FOLLOWED BY ION EXCHANGE ON INORGANIC EXCHANGE MATERIALS. Johnson, G. L.; Fowler, E. B. (Los Alamos Scientific Lab., N. Mex.). May 15, 1967. Contract W-7405-eng-36. 8p. Dep. CFSTI.

A method is described for the separation of trace amounts of

plutonium from macro amounts of platinum. Platinum solutions, prepared from the metal contaminated with plutonium, are subjected to several scavengings with ferric ion. The resulting precipitates of hydrous ferric oxides are filtered and the final filtrate treated with hydrogen peroxide and nitric acid to reduce the plutonium to a form which will be retained by the ion exchange medium. Subsequent treatment by passage through a column of either ammonium molybdophosphate or zirconium phosphate serves to remove any residual plutonium remaining after coprecipitation with ferric ion. The method is rapid and efficient, giving high decontamination factors under the conditions studied. (auth)

34318 (NP-16709) RECUPERACION DE Mo EN LOS LICORES AGOTADOS EMPLEADOS EN LA EXTRACCION DE URANIO. (Recovery of Mo From Solutions Used in Uranium Extraction). Carrasco Abrego, Hector (Universidad Nacional Autonoma de Mexico, Mexico City. Escuela Nacional de Ciencias Quimicas). 1963. 54p. (In Spanish). Dep.

Thesis.

The pH and temperature conditions necessary for the recovery of Mo from the spent liquors used in the alkaline extraction of uranium from tyuyamunita ores were determined. The experimental results showed that ferric sulfate, calcium oxide, and barium chloride were not as effective as the precipitation of calcium molybdate by calcium chloride. The optimum pH for the precipitation is between 6.5 and 7.0, independent of the temperature. At 20°C with the pH cited there is a recovery efficiency higher than 90.0%. The economic limit for the recovery of Mo is the minimum concentration of 11.33 g/l. (J.S.R.)

34319 (NP-16845) SALINE WATER CONVERSION REPORT FOR 1966. (Office of Saline Water, Washington, D. C.). 365p. GPO $1.75.

The 1966 operations of the Department of the Interior regarding the desalting of sea and brackish waters are summarized. Topics covered are grouped under the following headings: properties of solutions, solution chemistry, liquid-vapor processes, liquid-state processes, precipitation and crystallization, mineral recovery and brackish water, reverse osmosis, electrodialysis, biomembranes, freezing studies, reactions and transport phenomena at surfaces, corrosion studies, distillation, hydrate processes, and feasibility studies. (M.C.G.)

34320 (RFP-858) PROCESS VESSEL CALIBRATION, A TOOL FOR CONTROLLING MATERIAL UNACCOUNTED FOR (MUF). Doher, L. W. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). June 12, 1967. Contract AT(29-1)-1106. 8p. Dep. CFSTI.

A method is described for locating and measuring nuclear material accumulations within the process vessels of a nuclear processing plant. The method was developed because if these unrecovered materials are not located and measured, the discrepancies between actual and calculated inventories remain unresolved. In this method, computerized calibration reports giving the volumes of process vessels are compared. Differences of volume that can be related to time and quantity of product-throughput are used for estimating accumulations of solid material. This feature enables the manager of a processing plant to rapidly determine the feasibility of solid-material recovery. Proposed refinements, to this method, include the utilization of the computer to provide current data from which the plant manager can predict the accumulation of SS material. (auth)

34321 (ORNL-tr-1717) SEPARATION OF ^{152}Eu, ^{241}Am, AND ^{248}Cm BY ELECTROPHORETIC FOCUSING, USING SODIUM POLYPHOSPHATE AS COMPLEXING AGENT. Marcu, Gheorghe. Translated for Oak Ridge National Lab., Tenn., from Stud. Univ. Babes-Bolyai, Ser. Chem., 11: No. 2, 61-6(1966). 9p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

The separation of some rare earths (^{152}Eu, ^{147}Pm) and of some transuranium elements (^{241}Am, ^{248}Cm) using as a complexing agent sodium polyphosphate at various concentrations by the electrophoretic focusing method is described. The experiments were carried out on No. 4 Whatman paper at a potential difference of ~900 V. The duration of separation was 8 minutes. The best separations were obtained when using the sodium polyphosphate at ~0.02M. In these conditions at pH ~2.45 the ^{152}Eu separated well from ^{248}Cm and ^{147}Pm from ^{241}Am. The best separation of ^{152}Eu from ^{147}Pm was obtained at pH ~5.50. The ^{248}Cm did not separate from ^{241}Am except at pH ~7.0, when the distance between their concentration zones is 8 mm. In the presence of europium and promethium the effectiveness of this separation increases to 14 mm. For group separation of the transuranium elements from rare earths, the best results were obtained at pH ~2.45, when the distance between zones is 12 mm. (auth)

34322 NUCLEAR FUEL REPROCESSING RESEARCH AND DEVELOPMENT. Engineer, 224: 94-6(July 21, 1967).

Fuel cycles and fuel management are reviewed in the light of the development in the U. S. of improved converter and breeder reactors. Factors involved include higher fuel burnups and specific powers, higher radiation intensities, higher rates of decay-heat generation, higher concentrations of ^{131}I and ^{133}Xe, increased inventories of fertile material, increased emphasis on recycling expediently fuel discharged from reactors, and higher concentration of plutonium with its attendant magnification of criticality problems. These factors are discussed in relation to fuel-cycle economics and waste management. (UK)

34323 EXTRACTION OF LANTHANIDES AND ACTINIDES BY ALKYLPHOSPHINE OXIDES. PART III. EXTRACTION OF NITRIC ACID BY SOME DIPHOSPHINE OXIDES. Goffart, J.; Duyckaerts, G. (Laboratoire de Chimie Analytique et Nucleaire, Liege). Anal. Chim. Acta, 39: 57-71(Sept. 1967). (In French).

The distribution of nitric acid between an aqueous phase of constant or variable ionic strength and a benzene solution of diphosphine dioxide can be explained by the following reactions $H_a^+ + NO_{3_a}^- + DiPO_b \rightleftharpoons DiPO \cdot HNO_{3_b}$ $H_a^+ + NO_{3_a}^- + DiPO \cdot HNO_{3_b} \rightleftharpoons DiPO \cdot 2HNO_{3_b}$. At constant ionic strength, the stability constants K_I'' were determined for the complexes 1.1-DiPO·HNO_3 (9.8 ± 0.1 $(M)^{-1}$), 1.4-DiPO·HNO_3 (44 ± 3 $(M)^{-1}$) and 1.5-DiPO·HNO_3 (5.1 ± 1 $(M)^{-1}$). The constants K_{II}'' for the complexes 1.1-DiPO·2 HNO_3 and 1.5-DiPO·2 HNO_3 are respectively 0.35 ± 0.01 $(M)^{-1}$ and 6.2 ± 0.05 $(M)^{-1}$ at 25°. With an aqueous phase of variable ionic strength, values of $K_I' = 54 \pm 7$ $(M)^{-2}$ for 1.5-DiPO·HNO_3 and $K_{II}' = 6.5 \pm 0.4$ $(M)^{-2}$ for 1.5-DiPO·2 HNO_3 were obtained. (auth)

34324 AMORPHOUS AND CRYSTALLINE CERIUM(IV) PHOSPHATE AS ION EXCHANGER. II. ION-EXCHANGE CHARACTERISTICS TOWARD MONOVALENT CATIONS. Koenig, K.-H.; Meyn, E. (Univ., Frankfurt am Main). J. Inorg. Nucl. Chem., 29: 1519-26(June 1967). (In German).

In weak mineral acid solutions Ce(IV) phosphates of different origin exhibit variable sequences of sorption depending on structure. This is true for Na, Cs, and Ag in tracer as well as in macro amounts. Crystalline Ce(IV) phosphates produced in sulfuric acid medium are efficient cation exchangers. Towards macro amounts of these elements they show the sequence Cs < Na < Ag, and towards tracer amounts the sequence Na < Ag < Cs. Amorphous Ce(IV) phosphates, however, display almost the same sorption-sequence for macro and tracer amounts (Na < Ag < Cs). Pure crystalline Ce(IV) phosphate exhibits just tracersorption (Cs < Na < Ag). (auth) (UK)

34325 STUDYING THE SEPARATION OF ^{131}I FROM RADIOACTIVE SOLUTIONS BY MEANS OF ION EXCHANGERS USING BENTONITES. Lambrino, Vl. Rev. Chim. (Bucharest), 18: 292-5(May 1967). (In Rumanian).

Decontamination with an efficiency of 83% using bentonite of the calcic montmorillonite type with high ionic exchanging capacity for cations, for the anion ^{131}I from radioactive solutions with low activities is described. Two hypotheses of anion retention are discussed. (P.C.S.)

34326 THE PARTITION FUNCTION RATIOS OF ISOTOPICALLY SUBSTITUTED MOLECULES CALCULATED BY USING THE UREY-BRADLEY-SIMANOUTI POTENTIAL FUNCTION. Knyazev, D. A.; Bantysh, A. N.; Ivlev, A. A. (Mendeleev Inst. of Chemical Engineering, Moscow). Kernenergie, 10: 149-57 (May 1967). (In Russian).

Previous attempts to calculate general laws of the thermodynamics of isotope systems, e.g., enabling the evaluation of isotope exchange processes with respect to their applicability in isotope separation, failed because of the absence of a suitable potential function, from which the partition function ratios (β factors) of a system could be derived in good agreement with the experimental results with general validity, utilizing the isotopic shifts of the vibration frequency occurring in the potential function. Using the Urey-Bradley-Simanouti mixed potential function, good approach of the frequency shifts calculated to the experimental results and very high accuracy in calculating the β factors were obtained for 17 molecules of the XY_2, XY_3, XY_4 types. (auth)

34327 COMPLEX ADSORPTION OF URANIUM AND IRON ON STRONGLY BASIC ANION-EXCHANGE RESINS. Wolf, F.; Kinawi, A. (Martin Luther Univ., Halle, Ger.). Kernenergie, 10: 157-61(May 1967). (In German).

Both kinetics and adsorption during the co-action of uranium and ferrous sulfate complexes in H_2SO_4 solutions of strongly basic anion exchange resins were studied. The corresponding selectivity series as well as the limits of separability of uranium and ferrous sulfate complex mixtures are discussed. (auth)

34328 RAPID RADIOCHEMICAL SEPARATIONS AND STUDIES OF SOME NUCLEAR PROPERTIES. Rengan, Krishnaswamy. Ann Arbor, Mich., Univ. of Michigan, 1966. 128p.

Thesis.

Rapid separation of different rare earth elements was accomplished with a small ion exchange column (Dowex 50) and α-hydroxyisobutyric acid. Individual rare earth fractions can be obtained with controlled concentration and pH of the eluant. Good separation (peak to valley ratios of 50 to 100 in the total activity of the elution fractions) was obtained in about 10 min for rare earths differing in atomic number by 4 or more. Less complete, but usable separations of adjacent rare earths, such as Gd and Tb, can be made in about 16 min. This rapid separation procedure was used for the determination of rare earths by activation analysis. Samples such as monazite and the U. S. Geological Survey samples G-1 and W-1 were studied. The applicability of this method for the entire group (Yb and Pr) was investigated. Two rapid radiochemical procedures were developed for Se. In the first Se(IV) is extracted into 2,6-dimethyl-4-heptanone, is purified from other contaminants by washing with complexing agents and finally the Se stripped by oxidizing it to Se(VI). This procedure gives good decontamination from other fission products and can be accomplished in about five minutes. In the second procedure the fission product Se is exchanged with freshly precipitated Se metal. Further decontamination is achieved by making use of ion-exchange and isotopic-exchange principles. This procedure takes about 100 sec. The decay characteristics of ^{84}Se were studied. This nuclide was found to have a half-life of 3.1 ± 0.2 min and to decay predominantly by a 1400 ± 100-keV β transition followed by 399 ± 5-keV γ ray. No other γ rays were detected in the decay. A β transition to the ground state of ^{84}Br was not detected, and an upper limit of 10% is placed for this mode of decay. The 399-keV level in ^{84}Br is interpreted as being 1^+ and the ground state of ^{84}Br is interpreted as being 2^-. Evidence was sought for the production of the reported (1- to 2-hour) ^{129}Sn isomer in thermal fission of ^{235}U. Tin was separated from fission products after the 6.2-min ^{129}Sn had decayed. No ^{129}Sb was found to grow in the sample. An upper limit of 10^{-3}% was obtained for the cumulative fission yield of a 1.8-hour ^{129}Sn isomer. Similarly no evidence was found for the presence of 1.6-hour ^{131}Sn isomer and an upper limit of 1.7×10^{-4}% can be fixed for the cumulative fission yield of this isomer. A low intensity positron branch was detected in the decay of ^{105}Ag. This detection was accomplished by coincidence counting of the positron annihilation quanta. A value of $(8.4 \pm 1.4) \times 10^{-3}$ positrons per ^{105}Ag disintegration was obtained. The energies and intensities of the gamma rays emitted in the decay of ^{105}Ag were determined using NaI(Tl) and lithium-drifted Ge detectors. The life-time of the 344-keV level was shown to be less than 50 nanoseconds. (Disser. Abstr.)

34329 METHOD FOR REPROCESSING MOTHER LIQUORS DERIVED FROM THE PRECIPITATION OF PLUTONIUM BY OXALIC ACID. Bathellier, Andre (to Commissariat a l'Energie Atomique). British Patent 1,073,115. June 21, 1967. Priority date Aug. 25, 1964, France.

A process is described for extracting Pu by contacting the Pu-containing solution with a solution of trilaurylamine in an organic solvent, mixing the trilaurylamine/organic solvent extract with an aqueous solution of H_2SO_4 or a mixture of H_2SO_4 and HNO_3, adding oxalic acid to the aqueous acidic solution, and separating the precipitated Pu from the mother liquor. The mother liquor is then recycled without any preliminary treatment. (B.L.M.)

34330 METHOD FOR THE REPROCESSING OF URANIUM-CONTAINING NUCLEAR FUELS. (to Kernforschungsanlage Juelich des Landes Nordrhein-Westfalen eV). British Patent 1,073,000. June 21, 1967. Priority date Nov. 21, 1964, Germany.

A method for the reprocessing of U-containing nuclear fuels includes fluorination by mixing the fuel with an inert substance, for example fused corundum or fluorspar, and heating to a temperature in the range from 800 to 900°C with SF_6. The fluorination may be carried out in a fluidized-bed-type reactor, and an oxidizing agent may be mixed with the SF_6. After mechanical comminution, the method is applicable to coated nuclear fuel particles. (B.L.M.)

EARTH SCIENCES

Geology

Refer also to abstract 34348.

34331 (BNWL-CC-539) STATISTICAL ANALYSIS OF CESIUM AND STRONTIUM SORPTION ON SOILS. Ames, L. L. Jr.; Hajek, B. F. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 8, 1966. Contract AT(45-1)-1830. 11p. Dep. CFSTI.

A statistical design to study removal of radioisotopes by a soil was tested. A simple two-level factorial utilizing $NaNO_3$, KNO_3, HNO_3 and $Ca(NO_3)_2$ as independent variables yielded satisfactory cesium and strontium removal results. A regression equation was used to predict cesium and strontium removal results, given the level of independent variables. The results indicate the statistical treatment and prediction of radioisotope removal by soils is feasible. (auth)

34332 THEORY OF THE NUCLEAR DENSIMETER. Taylor, Denis; Kansara, Mohan (Univ. Coll., Nairobi, Kenya). Soil Sci., 104: 25-34(July 1967).

The design theory and optimum application procedures are presented for an instrument to measure soil density by gamma photon absorption or scatter. The theoretical accuracy of using a simple back-scattering gage and the effects of soil types and moisture content on measurement accuracy are discussed. Results show that the back-scattering gage has two main sources of error: the back-scattering, which increases with density; and the attenuation along the two-way transmission path through the soil, which has the effect of decreasing the signal with increase of density. Although the back-scattering gage shows more error source than a direct transmission type of gage, the moisture content variations of the soil cause the back-scattering gage to give more accurate readings than the direct transmission gage under similar moisture variations. (D.C.C.)

34333 EVOLUTION OF THE EARTH CRUST ACCORDING TO DATA ON THE ISOTOPES OF MINERAL LEAD. Naidenov, B. M.; Cherdyntsev, V. V. (Kazakh Inst. of Mineral Resources, Geological Inst., Alma-Ata, USSR). Dokl. Akad. Nauk SSSR, 172: 688-91(Jan. 21, 1967). (In Russian).

The buildup of isotopes in the crust of the Earth is a continuous process; however, deviations were observed concerning the isotopic concentration of lead in the Proterozoic period. In order to explain this behavior, the decay curves were analyzed, in order to obtain an indication as to the removal or addition of radioelements or of lead. From a statistical treatment of thousands of isotopic concentrations of lead in minerals of various ages, the expression describing the regression curves was derived. Ratios of $^{238}U_c/^{204}Pb$, $^{232}Th_c/^{204}Pb$, $^{235}U_c/^{204}Pb$, and $^{232}Th_c/^{238}U_c$ were determined for various geological eras. If the Earth's crust were a closed system, these ratios should remain constant but the variations which amounted to 12% exceed the limits of experimental error. As the crust is relatively enriched in radioelements and lead with respect to the mantle, it was assumed that the change is due to the addition, rather than to the removal of these elements. After a maximum in one to two billion years, a reduction was noted in more recent geological formations, caused by the decay of the transuranium isotope and accumulation of its decay products. Indeed, recent igneous rocks exhibited an excess of ^{207}Pb. (TTT)

34334 APPLICATION OF RADIOMETRY FOR PRELIMINARY EVALUATION OF THE OIL PRODUCTIVITY OF STRUCTURES. Borchaninov, N. K. Petrol. Geol. (USSR) (Engl. Transl.), 6: No. 9, 542-5(Dec. 1966).

Oil exploration by use of the natural field of intensity of γ radiation was investigated. It was established that most of the investigated oil fields of the platform, geosynclinal, and salt-dome type correspond to anomalies expressed by low values of the natural γ field and of the content of radioactive and stable trace elements in the section of the rocks above oil and gas pools, and by relatively high values in the marginal zones. It was found that oil pools of the Shaim area exhibit the same regularities in the distribution of the γ field and of trace elements in the section as do the pools of most oil provinces investigated. The anomalous effect of a drop in the γ radiation of rocks along a section (in wells that penetrate oil pools and in those that do not) decreased from the bottom upward. Zones of low values of the γ field are most reliably distinguished by taking into account the lithology of the rocks at depths greater than 2 m. Decrements in γ activity of rocks within zones of low values distinguished in the section of rocks of the upper cover amounted to 10 to 40% of the background values. This permitted them to be distinguished by field radiometry with a high threshold sensitivity. The systematic occurrence of anomalous low values of the γ field above oil pools permits use of the radiometric method for preliminary evaluation of the oil productivity of a structure using γ logs of seismic shot holes. (BBB)

34335 ^{239}Pu IN NATURE. Cherdyntsev, V. V.; Kazachevskii, I. V.; Sulerzhitskii, L. D.; Kuz'mina, E. A. (Geological Inst., Moscow). Geochem. Int. (Engl. Transl.), 2: 918-20(1965).

The occurrence of Pu in some natural minerals was studied. Plutonium was separated from the other elements in ion-exchange columns and precipitated electrolytically on Ni-plated tablets used for activity measurements by an ionization α spectrometer. The yield of ^{239}Pu was controlled by adding the carrier ^{238}Pu; it amounted to 5 to 20%. The association of this α radiation source, with an energy of 5.15 MeV, with the Pu isotopes was confirmed by reprecipitation of some samples: this radiation source always followed the ^{238}Pu. A typical α spectrogram is illustrated. A considerable number of mineral samples (over 300) from natural sources did not contain measurable amounts of ^{239}Pu. The content of ^{239}Pu in natural waters was as high as $n \times 10^{-13}$ g/l, with $\alpha = n \times 10^{-7}$, which is many times higher than for U minerals; as such, it indicates a different source of Pu enrichment. This isotope was identified in deep carbonate waters, as well as in some fresh waters, namely in waters of ore vein areas. Among the Pu-bearing minerals of ore veins were sphene, molybdenite, magnetite, and particularly apatite (3.6×10^{-12} g/g) and zircon (2.9×10^{-12} g/g). Among the Quaternary deposits, Pu was observed in ferruginous carbonates and exhalation products of submarine volcanism. The low Th/U ratio in these products suggests that the ore substance was not likely enriched by radioelements from the ocean waters, nor was there any likelihood of an industrial origin for ^{239}Pu. Furthermore, Pu was qualitatively identified in middle Pleistocene soils (Siberia), calcareous tuffs, and some formation waters. (BBB)

34336 BEARING OF LEAD ISOTOPES ON THE SOURCE OF GRANITIC MAGMA. Doe, Bruce R. (Geological Survey, Denver). J. Petrol., 8: 51-83(Feb. 1967).

The isotopic composition of lead was measured in Mesozoic and Cenozoic igneous rocks (including volcanic glasses, olivine basalts, and potassium feldspars from granitic rocks) of the coastal region (California, Oregon, and Washington) —where melting is possible at the bottom of a Phanerozoic sedimentary pile—and in similar rocks of the continental interior region (Rocky Mountain provinces, southwestern New Mexico, South Dakota, and Texas) —where Precambrian rocks are shallow or surround the Mesozoic and Cenozoic igneous rocks at the surface. The coastal region is typified by a narrow range in lead isotopic composition and by isotope ratios more radiogenic than expected from closed system models (J type). The continental interior region is typified by a broad range in lead isotopic composition, even within an individual magmatic complex such as the Boulder batholith, and by at least one isotope ratio that is less radiogenic than expected from closed system models (B type) and than found in the coastal region. If, as suggested by available data in the literature, most Precambrian and Paleozoic granitic rocks have leads more radiogenic than closed system models predict by the time of the Cenozoic Era, granitic rocks, in the continental interior region at least, cannot form by complete melting of older granitic rocks. The rocks may have been formed by one of the following mechanisms: differentiation from or partial melting of a basaltic-gabbroic parent coupled with crustal assimilation, differentiation or partial melting from a basaltic-gabbroic parent having U/Pb and Th/Pb characteristics in the continental interior different from those of the coastal regions and ocean basins, and partial melting of upper crustal rocks. The differences in isotopic characteristics of the igneous rocks in the coastal and continental interior regions can be explained if the predominant crustal assimilation takes place in the upper crust through partial assimilation of Phanerozoic or Precambrian rocks, whichever happen to be present near the surface in the area or, if some other mechanism occurred, such as partial melting of the mantle in coastal regions and partial melting of the lower crust in the interior regions. (auth)

34337 IONIC EXCHANGE BEHAVIOR IN A LOAM SOIL AS INDICATED BY MOVEMENT OF RADIOCALCIUM. Arshad, M. A. (Research Council of Alberta, Edmonton); Carson, J. A. Soil Sci. Soc. Amer., Proc., 31: 321-4(May-June 1967).

Soil columns were used to study the movement of ^{45}Ca by leaching them with salt solutions of various concentrations and ionic combinations. The results showed that the distribution patterns of radio-calcium within the soil columns varied with the anionic

species as well as with the type of cations of the salt solutions. Exchange and movement of radio-calcium was higher with sulfate than with chloride salt solutions. The difference is explained on the basis of the differential displacement of calcium from the exchange sites caused by the salts present in soil solution. The data obtained may have significance in understanding the development of solonetzic soils. (auth)

34338 EXTRATERRESTRIAL EXCESS ^{36}Ar AND ^{38}Ar CONCENTRATIONS AS POSSIBLE ACCUMULATION-RATE INDICATORS FOR SEA SEDIMENTS. Tilles, D. (Smithsonian Institution Astrophysical Observatory, Cambridge, Mass. Harvard Univ., Cambridge, Mass.). Icarus, 7: 94-9(July 1967).

Measurements of excess ^{36}Ar and ^{38}Ar, released at high temperatures from mineral concentrates of fine-grained sediment, may be useful for determining average sedimentation rates in marine sediments. Assumptions are required about long-term average constancy of influx of interplanetary dust to Earth, of rare-gas concentration in this dust, and about mineral stability in the marine environment. These assumptions can be examined experimentally by study of samples whose sedimentation rate is reliably determined by other methods. If the necessary conditions are fulfilled, the greatest attractions of this method are its universal applicability, its independence of local geochemical environment or geologic history, and its nonlimitation by half-life. (auth)

Meteorology

34339 RESULTS OF OBSERVATIONS OF RADIOACTIVITY AND ELECTRIC FIELD OF ATMOSPHERE AND CLOUDS IN EASTERN PASS OF GEORGIA. Chkhenkeli, Sh. M.; Khundzhua, T. G.; Sakvarelidze, E. A. Soobshch. Akad. Nauk Gruz. SSR, 45: 589-93(Mar. 1967). (In Georgian).

Vertical probing of the atmosphere to study the distribution of the concentration of radon decay products in relation to some meteorological factors was done by means of Li-2 aircraft by the filtration method. Flights were made in cumulus clouds and, aside from the radioactivity of the air, the vertical components of the electric field and humidity of the cloud were measured. The results of nine flights were reported. In three of five vertical probings, a temperature inversion was observed at different altitudes and a corresponding accumulation of radon induction. At the time of flights into clouds with complex topography, a direct dependence of the radioactivity of the atmosphere on the vertical components of the electric field of the atmosphere and an inverse dependence on the humidity of the cloud were observed. (tr-auth)

34340 EFFECT OF SOME IONS IN THE ATMOSPHERE ON THE FALLOUT IN 1964 TO 1966. Csupka, St. (Hygienisch-Epidemiologische Kreisinstitut, Bratislava). Kernenergie, 10: 164-8(May 1967). (In German).

The radioactive fallout on the territory of Western Slovakia/C.S.S.R. was observed during 1964 to 1966. The total beta-ray activity, the contents of ^{90}Sr and ^{137}Cs, the contents of stable ions in the fallout (Na^+, K^+, Cl^-, Ca^{2+}, SO_4^{2-}) as well as the salts dissolved in the atmospheric precipitations have been determined. The content of radioactive isotopes decreases continuously, and the voluminous atmospheric precipitations during 1965 did not raise the fallout radioactivity. The ion content in the fallout has been increased by the influence of the precipitations. Perhaps, the sedimentation of the radioactive and stable ions is effected by the atmospheric precipitations. The Na^+ concentration is mainly dependent on the atmospheric precipitations amounting to about 4 mg/l. in the mean. The $^{137}Cs/Na$ ratio was about 4 pCi/mg. (auth)

34341 GEOCHEMICAL FRACTIONATION OF ^{239}Np IN FRESH NUCLEAR DEBRIS THROUGH THE ATMOSPHERE. Sotobayashi, Takeshi; Suzuki, Toshio; Koyama, Seitaro (Niigata Univ., Japan). Bull. Chem. Soc. Jap., 40: 1555(June 1967).

Highly fractionated fission products, detected within 36 hr after the third Chinese nuclear test, were enriched with refractory fission products ^{97}Zr, ^{99}Mo, and ^{143}Ce and depleted in ^{132}Te and ^{133}I. Most of the particles were depleted in ^{239}Np, but some were markedly rich in ^{239}Np with no detectable amount of ^{132}Te and ^{133}I. The ^{239}Np seemed to behave refractorily in surface bursts. Data suggest that gravitational and meteorological forces and differences in size and density cause particle separation in an atomic cloud. Observations show fractionation behavior of ^{239}Np to be modified and that particle separation takes place in 1.5 days travel in the cloud. (F.S.)

Mineralogy

Refer also to abstract 34336.

34342 (JINR-P13-3159) OPREDELENIE KONTSENTRATSII URANA I EGO PROSTRANSTVENNOGO RASPREDELENIYA V RAZLICHNYKH MINERALAKH I GORNYKH PORODAKH. (Determination of the Uranium Concentration and its Spatial Distribution in Different Minerals and Rocks). Berzina, I. G.; Berman, I. B.; Gurvich, M. Yu.; Flerov, G. N.; Shimelevich, Yu. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1967. 20p. (In Russian). Dep.

Measurements were made of low concentrations of uranium and its spatial distribution in different minerals and rocks. Measurements were made in some minerals by spontaneous and induced fission of uranium nuclei revealed directly in these minerals, and in rocks and other materials by induced fission of uranium nuclei recorded by special detectors. The comparison of tracks from spontaneous and induced fission of uranium nuclei shows the migration of uranium within the time of mineral existence. Recommendations on practical use and selection of detectors and on the integral doses applied are given to determine different concentrations of uranium in the samples investigated. (auth)

34343 RUM JUNGLE: AUSTRALIAN URANIUM PROJECT. Stewart, J. R. (Atomic Energy Commission, Australia). Nucl. News, 10: No. 5, 27-31(May 1967).

A summary of the uranium production facilities in Australia is presented with particular interest in the Rum Jungle operation. Descriptions of the Mary Kathleen, South Alligator River area, and Radium Hill plants are also included. The description of Rum Jungle presents data on the site discovery, geological characteristics, mining facilities, production statistics, operational procedures, and environmental conditions for personnel. (D.C.C.)

Oceanography

34344 (RLO-1725-77) PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA FROM THE NORTHEAST PACIFIC OCEAN: COLUMBIA RIVER EFFLUENT AREA, JULY-DECEMBER 1963. Volume I. BROWN BEAR Cruise 329: July 8-19; HOH Cruise 73: August 7-25; BROWN BEAR Cruise 331: August 12-24; BROWN BEAR Cruise 332: August 24-28; BROWN BEAR Cruise 333: August 28-September 14. Technical Report No. 159. Barnes, Clifford A. (Washington Univ., Seattle. Dept. of Oceanography). Oct. 1966. Contracts AT(45-1)-1725; Nonr-477(10); Nonr-477(37). 262p. Dep. CFSTI.

Tabulated physical, chemical, and biological data collected during cruises 329, 331, 332, and 333 of the Research Vessel Brown Bear and Cruise 73 of the Research Vessel Hoh during the months of July to September 1963 in an area within 260 miles of the coasts of Washington and Oregon are presented. These data were collected as part of a year-round study which has as its objective the determination of the gross features of the movement and dispersion of Columbia River effluent water in the Northeast Pacific. (auth)

34345 (RLO-1725-78) PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA FROM THE NORTHEAST PACIFIC OCEAN: COLUMBIA RIVER EFFLUENT AREA, JULY-DECEMBER 1963. Volume II. BROWN BEAR Cruise 335 (Stations 1-144), September 20-October 12. Technical Report No. 159. Barnes, Clifford A. (Washington Univ., Seattle. Dept. of Oceanography). Oct. 1966. Contracts AT(45-1)-1725; Nonr-477(10); Nonr-477(37). 293p. Dep. CFSTI.

Tabulated physical, chemical, and biological data collected during Cruise 335 (Stations 1 to 144) of the Research Vessel Brown Bear during September and October 1963 in an area within 270 miles of the coasts of Washington and Oregon. These data were collected as part of a year-round study which has as its objective the determination of the gross features of the movement and dispersion of Columbia River effluent water in the Northeast Pacific. (auth)

34346 (RLO-1725-79) PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA FROM THE NORTHEAST PACIFIC OCEAN: COLUMBIA RIVER EFFLUENT AREA, JULY-DECEMBER 1963. Volume III. BROWN BEAR Cruise 335 (Stations 145-225), October 15-26. Technical Report No. 159. Barnes, Clifford A. (Washington Univ., Seattle. Dept. of Oceanography). Oct. 1966. Contracts AT(45-1)-1725; Nonr-477(10); Nonr-477(37). 186p. Dep. CFSTI.

Tabulated physical, chemical, and biological data collected during Cruise 335 (Stations 145 to 225) of the Research Vessel Brown Bear during October 1963 in an area within 270 miles of the coasts of Washington and Oregon are presented. These data were collected as part of a year-round study which has as its objective the determination of the gross features of the movement and dispersion of Columbia River effluent water in the Northeast Pacific. (auth)

34347 (RLO-1725-80) PHYSICAL, CHEMICAL, AND BIOLOGICAL DATA FROM THE NORTHEAST PACIFIC OCEAN:

COLUMBIA RIVER EFFLUENT AREA, JULY–DECEMBER 1963. Volume IV. BROWN BEAR Cruise 339: December 3–12; OSHAWA Cruise 4: December 10–20. Technical Report No. 159. Barnes, Clifford A. (Washington Univ., Seattle. Dept. of Oceanography). Oct. 1966. Contracts AT(45-1)-1725; Nonr-477(10); Nonr-477(37). 188p. Dep. CFSTI.

Tabulated physical, chemical, and biological data collected during Cruise 339 of the Research Vessel Brown Bear and Cruise Oshawa-4 of the CNAV Oshawa during December 1963 in an area within 650 miles of the coasts of Washington and Oregon are presented. These data were collected as part of a year-round study which has as its objective the determination of the gross features of the movement and dispersion of Columbia River effluent water in the Northeast Pacific. (auth)

Seismology

34348 (LA-DC-8718) GROUND VIBRATION CHARACTERISTICS OF MESITA DE LOS ALAMOS. Keller, M. Dean; Foster, Eric S. (Los Alamos Scientific Lab., N. Mex.); Werner, Frank H. (Coast and Geodetic Survey, Albuquerque, N. Mex. Seismological Lab.). [1967]. Contract W-7405-eng-36. 31p. (CONF-670804-1). Dep. CFSTI.

From Symposium on Wave Propagation and Dynamic Properties of Earth Materials, Albuquerque, N. Mex.

The foundation material which must support the Los Alamos Meson Physics Linear Accelerator is a welded tuff of volcanic origin. Its physical properties are neither perfectly elastic nor inelastic, and its characteristics with respect to amplification or attenuation of vibrations were unknown to a satisfactory degree. Prior to design of critical components for the Meson Physics Linear Accelerator, it was necessary to determine these characteristics with sufficient reliability to provide for economical designs of buildings and critical machine components. Those forces which could be duplicated, such as heavy truck traffic and impact loading, were duplicated and the vibrations resulting therefrom were recorded. Natural microseisms were recorded. High explosives were detonated on Mesita de Los Alamos, and the relationship between size of charge, distance, frequency, velocity, acceleration, displacement and Fourier spectra coefficients was established. The results obtained from these tests will be used in the dynamic analysis of components comprising this facility. Two tests of this series, the impact tests and the high explosive detonation tests, are described. (auth)

34349 (SC-CR-67-2644) CALCULATED GROUND MOTIONS FROM SNOW BALL. Final Report. Teatum, Eugene; Andrews, Dudley (Physics International Co., San Leandro, Calif.). Sept. 30, 1965. Contracts AT(29-1)-789; 74-0461. 55p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

The results of a calculational program intended to predict ground disturbance as a result of the Snow Ball event are described. Such calculations were made using one- and two-dimensional, time-dependent, Lagrangian, plastic-elastic hydrodynamic codes. Considerable effort was also expended in an attempt to arrive at a good model to describe the earth medium. Excellent agreement was found between predicted and experimentally-measured shock-arrival-time profiles in the close-in region. (auth)

ENGINEERING

Nuclear Explosions

Refer also to abstract 34341.

34350 (AD-634204) THERMAL EFFECTS OF NUCLEAR WEAPONS. LITERATURE SUMMARIES. Sachs, Abner; Harris, Dorothy (Institute for Defense Analyses, Arlington, Va. Economic and Political Studies Div.). Jan. 1966. Contract OCD-OS-63-134. 328p. (RP-P-221; IDA-HQ-66/4480). CFSTI.

Information from 40 papers published on the thermal effects of nuclear weapons is summarized for use in developing a thermal effects model to be part of a generalized damage assessment model for the effect of nuclear weapons on the inhabitants and economy of a city. Tables, figures, and other supporting data are presented. Because of continuing interest in developing the methodology of a thermal effects submodel, the literature will be surveyed and pertinent data summarized in later addenda to this volume. (F.S.)

34351 (AD-649897) STATIC-PRESSURE TESTS OF THIN-WALLED BOX STRUCTURES. Short, Robert D. Jr. (David Taylor Model Basin, Carderock, Md. Structural Mechanics Lab.). July 1960. 10p. (DTMB-1447). CFSTI.

Six medium-steel boxes were collapsed under external air pressure to obtain criteria for the design of deckhouses of ships subjected to nuclear air blast. All boxes failed by plastic buckling of the edges. For two unreinforced cubes doubling the ratio of plate thickness to plate width quadrupled the collapse pressure. Reducing the aspect ratio (plate length to plate width) from 2.0 to 1.0 resulted in an increase of strength of 84 percent for two boxes with no edge reinforcement. A box reinforced along the edges failed at a pressure 3.4 times as great as the pressure at which an unreinforced box of equal weight failed. (auth) (TAB)

34352 (AD-654503) A DETECTOR ANGLE INTEGRATION PROGRAM DESIGNED TO OPERATE ON THE NGM CODE OUTPUT. Hampton, W. Charles (Army Nuclear Defense Lab., Edgewood Arsenal, Md.). June 1967. 30p. (NDL-TM-37).

The Los Alamos Scientific Laboratory (LASL) is preparing a Neutron Gamma Monte Carlo (NGM) transport code that will provide differential data for use in mapping the initial radiation environment created by a nuclear detonation. The NGM output provides fluxes at a series of detectors, normalized to one neutron which leaves the source in the given source-energy solid-angle group. By appropriately weighting the output and integrating it with respect to the variables, the radiation field of given weapons can be mapped. A set of codes has been generated at US Army Nuclear Defense Laboratory (USANDL) for use in integrating the fluxes over the variables (source energies and angles, detector energies, angles and times), with appropriate weighting where necessary to provide input for special problems. A digital computer program written for the GE-225 Computer (16k core storage and 6 magnetic tape drives) in the GE-220 Series Tape Fortran language is described. The program integrates the LASL NGM radiation transport code differential flux output, weighted by a user-supplied function, with respect to the detector-angle variables. The resultant output is the flux at the detectors, integrated over detector angles, appropriately weighted for anisotropy of detector response. The method of performing the weighted detector-angle integration operation and the use of checksums to minimize error are given through the use of a flow diagram with complementary textual description and the Fortran source-deck listing. (auth)

34353 (SC-WD-67-426) ENVIRONMENTAL DATA BANK INDEX: UNCLASSIFIED ENTRIES. Gens, M. B. (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 48p. Dep. CFSTI.

In an effort to determine the environment to which the equipment designed by Sandia Corporation will be exposed, a "data bank" of environmental information has been compiled. Measured quantities resulting from field tests or actual use are continually being summarized to establish envelopes of inputs and responses. This material is being collated, microfilmed, and filed under 15 basic categories of environment. By consulting this data bank, a user has at his immediate disposal numerical definitions of the environments to aid in establishing design requirements and test plans. (auth)

Facilities and Equipment

Refer also to abstracts 34419 and 34896.

34354 (AERE-M-1214) CLEAN-UP OF SUBMICRON PARTICLES BY CONDENSING STEAM. Goldsmith, P.; Stinchcombe, R. A. (Atomic Energy Research Establishment, Harwell (England)). May 1963. 27p. Dep. CFSTI.

The result of the work on industrial-scale clean-up of gases containing radioactive particles by diffusiophoresis are presented. The main purpose in analyzing the combined results is to provide information for the pressure supression and clean-up system design for the Steam-Generating Heavy-Water-Moderated Reactor (SGHWR). (D.C.C.)

34355 (CONF-670619-1) A REPORT ON IN-PLACE SPRAY TREATMENT OF COOLING TOWERS AT THE PADUCAH GASEOUS DIFFUSION PLANT. Burkhalter, L. C. (Paducah Gaseous Diffusion Plant, Ky.). [1967]. Contract W-7405-eng 26. 9p. Dep. CFSTI.

From Cooling Tower Institute Meeting, New York.

The development of equipment and the operational procedures for in-place spraying of the Paducah Gaseous Diffusion Plant cooling towers are presented. The spray application of sodium pentachlorophenate into the wood of the cooling towers was found to be the most economical and effective method of controlling microbiological attack. (D.C.C.)

34356 (IPP-4/23) BERECHNUNG DES STATIONAEREN MAGNETFELDES KREISZYLINDRISCHER SPULEN MIT RECHTECKIGEM WICKLUNGSQUERSCHNITT UND GLEICHMAESSIGER STROMDICHTE. (Calculation of the Time-Independent Magnetic Field of a Circular-Cylindrical Coil with Rectangular Cross-Section and Uniform Current Density). Poehlchen, R. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr. 1967. 31p. (In German). Dep.

A new method is presented for calculating the field intensity of a semi-infinite circular-cylindrical coil (inner radius zero) with uniform current density in the cross-section. The derivation of the term for the vector-potential and the components of the field intensity from the Maxwell equations for the coil mentioned above are briefly illustrated. On this basis a FORTRAN-program was written for the calculation of the resulting field of a number of coaxial coils of this type. (auth)

34357 (LA-DC-8835) USE OF A STEAM EJECTOR VACUUM SYSTEM IN A HIGHLY CORROSIVE FURNACE ATMOSPHERE. Bustamante, Santiago J. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 22p. (CONF-670911-1). Dep. CFSTI.

From 2nd Pan-American Congress of Mechanical and Electrical Engineering and Related Disciples, Caracas, Venezuela.

A steam ejector vacuum system was used to replace a conventional vacuum system used in evacuating three research furnaces. The highly corrosive atmosphere of the furnaces was attacking the booster and mechanical pump oils and most of the metal components of the conventional vacuum system. The costs involved in overhauling, replacing components, and the down-time had become prohibitive. A steam ejector vacuum system has replaced the conventional vacuum system and has been in use successfully for the past five years. (auth)

34358 (NAA-SR-12327) THE SYSTEMS-QUALITY SODIUM LOOP DESIGN, CONSTRUCTION, AND STARTUP. Murbach, E. W.; Bodine, J. E.; Heath, N. W. (Atomics International, Canoga Park, Calif.). May 31, 1967. Contract AT(04-3)-701. 38p. Dep. CFSTI.

A forced-circulation loop for the maintenance of a supply of systems-quality sodium was designed and fabricated. The loop was loaded with 150 gallons of reactor-grade sodium. After a few weeks of operation at 500°F with a cold trap at 260°F (oxygen control) and a hot trap at 1200°F (carbon control), the oxygen content was 10 ± 5 ppm and carbon content <15 ppm, the levels specified for systems-quality sodium. A summary description of the loop construction, with emphasis on the control instrumentation, is given. In addition, sampling procedures which were developed for this system are described and discussed. (auth)

34359 (RMO-3007) DESIGNS AND DESCRIPTIONS OF MECHANICAL SAMPLERS IN USE AT GRAND JUNCTION, COLORADO. (Pitkin (Lucius) Inc., Grand Junction, Colo. Western Uranium Project). Dec. 15, 1966. Contract AT(05-1)-912. 22p. Dep. CFSTI.

Descriptions and illustrations are presented of sampling systems and mechanisms used for sampling U concentrates purchased by the USAEC. The two methods of sampling described are: enclosed auger sampling for material of fine particle size and fairly

uniform moisture and U content; and falling stream sampling for all materials. (D.C.C.)

34360 (SC-DC-67-1901) [INSTRUMENTATION FOR ATMOSPHERIC DENSITY AND COMPOSITION MEASUREMENTS ABOVE 100 KILOMETERS]. Woods, R. O. (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 20p. (CONF-670710-2). Dep. CFSTI.

From American Astronautical Society Symposium, Denver, Colo.

A system is described for making density measurements in the atmosphere between 100 and 300 kilometers. Since the vehicle flight environment strongly influences densimeter (vaccum gage) design and the mode operation of the gage establishes criteria for the vehicle motion, then the design of the experiment involves a consideration of the system as a whole. This consideration is discussed with particular reference to the Nike–Tomahawk vehicle. Instruments used in earlier experiments are described, along with a discussion of the present generation of commercial gages and the modifications which are being made to enable them to meet the environmental conditions. A discussion of existing types of mass spectrometers and the relative merits of each for rocket applications is presented. The problem of providing a suitable ion source is also discussed. (D.C.C.)

34361 (SC-DC-67-1921) CALIBRATION OF THE SANDIA CORPORATION 6 x 200 FOOT EXPLOSIVE DRIVEN SHOCK TUBE. Bickle, L. W. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 13p. (CONF-670712-1). Dep. CFSTI.

From Conference on Military Application of Blast Simulators, Calgary, Alberta, Canada.

The Sandia Corporation 6 x 200 foot shock tube, which is driven by primacord explosive, has been calibrated for air, Freon C-318, and sulfur-hexafluoride (SF_6) as the test gas. The calibration covers test gas pressures ranging from 1 psia to 12 psia and explosive weights up to 300 pounds. The calibration information for each test gas consists of a set of curves that relate shock tube performance parameters, such as shock Mach number, flow Mach number, etc., to the "charge parameter" which is defined as the weight of primacord explosive divided by the product of the initial pressure of the test gas and the distance from the driver end of the shock tube. Presently, the accuracy of the calibration is limited by the manner in which the experimental data are processed and the assumption of an ideal test gas. However, this information should prove useful in the selection of a desired blast environment. (auth)

34362 (SWRI-1228P8-33) FUNDAMENTAL INVESTIGATION OF LIQUID-METAL LUBRICATED JOURNAL BEARINGS. Final Report. Burton, R. A.; Hsu, Y. C. (Southwest Research Inst., San Antonio, Tex. Dept. of Aerospace Propulsion Research). June 20, 1967. Contract AT(11-1)-1228. 245p. (RS-502). Dep. CFSTI.

Results of analytical and experimental research are presented on turbulent-film bearings applicable to short bearings with predominant end leakage, long tilted pads with predominant end leakage, long tilted pads with approximately tangential flow, and finite tilted pads. The problems of the turbulent squeeze film, when there is a relative velocity in the direction normal to the surface, and of the free surface with surface-tension effects are covered. Inertial effects and examples for solving the film equations are given. An annular-flow apparatus is described which is used to simulate conditions encountered by bearings in turbulent film flow. Equations are derived for thin lubricant films with end leakage and infinitely long turbulent squeeze films. Short journal bearings, bearings without end leakage, and tilted pads were analyzed. Basic equations for turbulent thin liquid films in the presence of surface tension are given. (F.S.)

34363 (TRG-Report-1404) IN-PILE IRRADIATION EQUIPMENT AND TECHNIQUES. A Selection of Papers by Members of the Reactor Engineering Laboratory to an International Symposium held at Harwell, 10–12 May 1966. Tilbe, H. E. (ed.) (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). Dec. 5, 1966. 110p. (CONF-660521). Dep. CFSTI. HMSO 15s. 0d.

A selection of papers which were submitted by the staff of the Reactor Engineering Laboratory UKAEA to an International Symposium held at Harwell May 10 to 12, 1966, are presented. The papers were divided into three parts: general technology, complex in-pile equipment, and operational experience. Separate abstracts were prepared for the 10 papers. (R.C.K.)

For abstracts of individual papers see: 34364–34372 and 34419.

34364 (TRG-Report-1404, Paper 1) HIGH-TEMPERATURE BELLOWS-SEALED VALVES. White, W. P. 10p.

A summary of some recent experiences with high-temperature bellows-sealed valves used with liquid metals and gases is presented. The present aims and lines of development are discussed and some new designs of valves are described. (auth)

34365 (TRG-Report-1404, Paper 2) HIGH-TEMPERATURE BOLTED FLANGED JOINTS. White, W. P.; Bromidge, N. A. C. 29p.

An extensive program has been carried out over seven years to develop demountable bolted flanged joints to meet exacting requirements for leak tightness at high temperatures and high pressures. Several proprietary joints were tested but none was satisfactory, so a new type was developed, using a thin soft metal gasket which is compressed plastically between controlled-finish surfaces on the mating hubs. The new design can be used in practically any environment when the right choice of materials is made, and it remains substantially leak tight at temperatures up to 600°C. The joint will withstand pressures significantly greater than the safe working pressures of the adjoining pipes, and its performance is not impaired by alternating applied bending moments or torsion of considerable magnitude. The results of exhaustive tests made on several sizes of joints are presented. The leak rates of the joints tested were $\sim 10^{-9}$ atm/cm^3 sec per cm peripheral length of gasket and were not measurably affected by changes of pressure. (auth)

34366 (TRG-Report-1404, Paper 3) GAS BEARING CIRCULATOR. Dornan, J.; Redstone, E. 11p.

The design of a totally enclosed gas bearing compressor for use at temperatures and pressures up to 300°C and 220 lb/in.^{2} abs, respectively, is presented. Experience gained from the operation of the machine is surveyed. (auth)

34367 (TRG-Report-1404, Paper 4) HEATERS FOR IRRADIATION EXPERIMENTS. M. I. Cables Over 1.5 mm Diameter. Thomson, A.; Braunton, C. B. T. 9p.

The designs of electric heaters which obtain up to 840°C and power inputs up to 750 watts are presented. The experimentally determined limitations of each heater material are also presented. (D.C.C.)

34368 (TRG-Report-1404, Paper 5) METAL-SHEATHED MINERAL-INSULATED BASE-METAL THERMOCOUPLES. Fenton, A. W. 9p.

Error sources in sheathed Chromel/Alumel wires are discussed. Thermally induced instabilities in the Chromel wire are shown to be the main cause of calibration drift. The effects of coolant penetrating the sheaths are described. Failure mechanisms together with some application and fabrication techniques are outlined. (auth)

34369 (TRG-Report-1404, Paper 6) USE OF CARBON DIOXIDE AT HIGH PRESSURES. Sheriff, N. 4p.

A method is presented by using stainless steel shields to prevent natural convection heat transfer by carbon dioxide flowing in the unfilled space in a graphite specimen carrier. By reducing the natural convection heat transfer, more accurate thermal readings are made in the experiment. (D.C.C.)

34370 (TRG-Report-1404, Paper 7) MAGNETIC FORMING. Denney, J. 2p.

The use of novel techniques of manufacture and assembly to meet the special needs of some modern equipment for experimental irradiations is described. (auth)

34371 (TRG-Report-1404, Paper 9) DEVELOPMENT WORK IN SUPPORT OF THE D.M.T.R. BOILING WATER LOOP. Middlebrook, H.; Bramfitt, A. C. F. 13p.

Development aspects of a small-scale pilot loop operated in the Reactor Engineering Laboratory to support the design and manufacture of an in-pile boiling water loop for water chemistry and corrosion problems associated with a ferritic steel reactor system are described. (auth)

34372 (TRG-Report-1404, Paper 10) OPERATING EXPERIENCE AND DEVELOPMENT ON WIGNER-TYPE RIGS. Cuthbertson, J. D. 5p.

A brief description of the type of rig commonly used for the irradiation of non-fissile materials and the kind of operational faults experienced is presented. The post-irradiation examination of failed rigs is reviewed, design weaknesses are noted and subsequent improvements are described. (auth)

34373 POSITIVE SPACE CHARGE AND NATURE OF THE REDUCTION IN REGION OF FIRST CRITICAL FREQUENCY. Zhukov, A. A. (Khabarovsk State Pedagogical Inst., USSR). Zh. Tekh. Fiz., 37: 710-16(Apr. 1967). (In Russian).

The breakdown of plane parallel air gaps at atmospheric pressure and frequencies between 0.1 and 20 MHz is studied. The breakdown potential is known to decrease with increasing frequency, beginning at a certain frequency called the first critical frequency. Earlier experiments of the author showed that the

reduction of the breakdown potential in the region of the first critical frequency is practically independent of the initial current; this result is in conflict with the theoretical conclusion of H. Bocker based on the assumption of a uniform distribution of positive space charge in the gap, that the reduction of the breakdown potential is proportional to the square root of the initial current, and it is concluded that the experimental results cannot be explained by such a space charge distribution. New measurements by the author of the differences between ac and dc breakdown potentials confirmed the findings of others that at frequencies close to but lower than the first critical frequency the ac breakdown potential is 1 to 2% higher than the dc breakdown potential. A semiempirical formula for the breakdown potential in the region of the first critical frequency is derived on the assumption of a spherical distribution of positive space charge. This formula is in agreement with the experimental data at frequencies above the critical frequency for gap lengths from 0.2 to 4 cm and frequencies from 0.1 to 10 MHz. The formula also gives an increase of the breakdown potential over the dc value at frequencies slightly below the critical frequency, but it is not in quantitative agreement with experiment in this region. (ATD)

34374 MASTER-SLAVE MANIPULATOR DEVELOPMENTS. Goertz, R. (Argonne National Lab., Ill.). pp 12-13 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

The ANL Mark E4A master-slave manipulator is described. The slave arm has a 50-lb force capacity in any direction with a one-to-one motion correspondence maintained between the master and slave. A 100-lb force electric master-slave manipulator which is now being designed under the term ANL Mark E4B is also described. The ANL Mark TV2 apparatus which has five head-controlled motions for TV monitoring of master-slave manipulator use is described. (D.C.C.)

34375 DIGITAL COMPUTER CONTROL OF A REMOTE MANIPULATOR. Mergler, H. W.; Beckett, J. T.; Hammond, P.; Taylor, R. (Case Inst. of Tech., Cleveland). pp 14-15 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

The feasibility of using digital computers to operate remote manipulation devices is presented. The algorithm implementing mode 1 system in which an operator specifies five variables (position and orientation of the "band") and the computer generates seven machine position variables is described. The operational mechanics of an experimental model consisting of a General Mills Model 100 manipulator modified to resemble a PaR Model 3000 and a DDP-116 computer for teletype mode control is presented. (D.C.C.)

34376 SUPERVISORY CONTROL OF REMOTE MANIPULATION. Ferrell, W. R.; Sheridan, T. B. (Massachusetts Inst. of Tech., Cambridge). pp 16-17 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

Methods of operating remote manipulators when tight servo loop capabilities are impossible are presented. One method relies on automatic equipment reprogrammed occasionally from the remote site. The second method combines two levels of control: a direct control at the remote site with lower level feedback processing and decision making handled by a digital or digital-analog computer; and supervision of the remote activities by an operator who sets sequences of subgoals, modifies the parameters of the remote system, and who compensates for the limited decision making ability of the remote device. Applications of these methods to experimental models are presented. (D.C.C.)

34377 REMOTE-CONTROL MASTER-SLAVE MANIPULATOR. Le Guennec, Rene (to CEA). British Patent 1,075,840. July 12, 1967. Priority date Dec. 28, 1964, France.

A master-slave manipulator is described which is used for remotely handling objects in a hot cell. The grab is designed with seven simultaneous degrees of freedom and high precision in its response to the initial action of the operator. There are no play or dead points in the performance of controlled movements. The apparatus is lightweight and perfectly balanced. (F.S.)

34378 SOLID TRITIUM AND DEUTERIUM TARGETS FOR NEUTRON GENERATORS. (to NRA, Inc.). British Patent 1,075,411. July 12, 1967. Priority date Oct. 4, 1963, United States.

An improved neutron source target including the method of forming the target are described. A base metal of high thermal conductivity such as Al, Cu, or stainless steel is coated with a deuteride or tritide of Ce, Dy, Er, La, Nd, Pr, Sc, Tb, or Y. In forming the target the metal base is loaded in a vacuum system and the Group III transitional or lanthanum series metal is loaded into the filament and evaporated on the base metal. The reaction chamber is isolated and an H isotope gas is introduced into the reaction chamber to form the improved solid D or T target material. (F.S.)

34379 IMPROVEMENTS RELATING TO EXTENSOMETERS. Kyle, James Clayton (to Physical Sciences Corp.). British Patent 1,071,577. June 7, 1967. Filed June 23, 1964.

An extensometer is described which is used to indicate specimen dimension changes in a detrimental environment, e.g., inside a nuclear reactor. Methods are provided for anchoring one end of the specimen, supporting and stressing the specimen, and maintaining the specimen at constant temperature. The design is remotely controlled. (F.S.)

34380 IMPROVEMENTS IN OR RELATING TO FOAM DEIONIZATION APPARATUS. Wace, Peter Frederick (to United Kingdom Atomic Energy Authority). British Patent 1,074,945. July 5, 1967. Filed Feb. 8, 1965.

Equipment and methods are described for use in foam deionization treatment. The equipment consists of a column, gas distributor, liquid inlet and outlet, and a foam outlet. Gas is passed into a liquid pool at the bottom of the column causing bubbling and foam formation above the pool. Foam passes up by causing turbulence and reformation of a stable foam which is withdrawn at the top of the column. Raffinate is withdrawn at the bottom. The solution to be deionized is introduced into the region of turbulence above the liquid pool. (F.S.)

34381 IMPROVEMENTS IN DEVICES FOR HANDLING RADIOACTIVE CHARGES. Loriot, Pierre; Mas, Roland Georges (to CEA). British Patent 1,075,819. July 12, 1967. Priority date July 28, 1964, France.

A remotely controlled device is described which is used in handling radioactive materials between two or more cells. One cell is used for high-activity work and one permits operator access. The device consists of traversing bridges in each cell, a self-propelled carriage adapted to run on roller tracks supported by the bridges, and an opening which allows the carriage to pass from one area to another. (F.S.)

34382 IMPROVEMENTS RELATING TO CHARGING MACHINES FOR NUCLEAR REACTORS. Montague, Eric; Cartwright, Frank; Honer, Ronald (to Fairey Engineering Ltd.). British Patent 1,074,282. July 5, 1967. Filed Mar. 12, 1963.

A mobile charging machine for a nuclear reactor is described. The machine is equipped with a visual guidance system. The guidance system comprises a closed-circuit television system with a monitor screen on which output from television cameras is displayed. The machine can be accurately positioned over any of the many hundreds of standpipes which lead to channels in the charging face. (F.S.)

34383 FILTER FOR INERT GAS MONITOR /Q-2351/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1616).

1 drawing.

A filter is described which consists of a charcoal trap which filters out iodine in an inert gas detector in a gamma-radiation monitoring system installed in the HFIR stock. The trap is used to remove iodine when the iodine monitor trap is saturated with iodine allowing the inert gas monitor to operate in the presence of quantities of iodine. (For details see TID-4100 Suppl. 41) (F.S.)

34384 F_2 CLEANUP REACTOR (Engineering Materials). (Oak Ridge Gaseous Diffusion Plant, Tenn.). (CAPE-1581).

37 drawings.

The cleanup reactor of the feed manufacturing plant used to produce UF_6 for diffusion cascades is described. UF_6 is produced from UO_2. The UO_2 is reacted with anhydrous HF gas to produce UF_4 in a hydrofluorination vibrating tray reactor. The UF_4 is fluorinated to UF_6 in a fluorination vibrating tray reactor similar to the hydrofluorination vibrating tray reactor. The first 10 ft section of the fluorination vibrating tray reactor is the cleanup reactor used to cleanup F from the reactor secondary recycle stream. Wiring diagrams and the design of the following equipment used with the cleanup reactor are described: the cleanup reactor furnace, tower, tower heater, tower feed screw, vibrator, preheater, ash hopper, cooling screw drive, hot hopper, and conveyors. (For details see TID-4100 Suppl. 41) (F.S.)

34385 CAPACITOR BANK MODULES (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–1620).
21 drawings.

Capacitor/switch-ignitron modules are described. These modules are assembled in numbers to create large capacitor banks. One assembly is used to house 5555 ignitrons. Both positive and negative mountings are described for Green River ignitrons. (For details see TID–4100 Suppl. 41) (F.S.)

34386 CONTROL CHASSIS FOR CAPACITOR BANK FIRING (Engineering Materials). (Univ. of California, Lawrence Radiation Lab., Livermore). (CAPE–1621).
28 drawings.

Chassis are described which are used at Toy Top, the magnetic mirror device. One chassis is used in monitoring the charge on large capacitor bank sections for interlocking purposes. Three other chassis are employed in firing the ignitron switch tubes of large capacitor banks. (For details see TID–4100 Suppl. 41) (F.S.)

34387 BEAM ANALYZING AND TRANSPORT SYSTEM FOR ANL 60 IN. CYCLOTRON (Engineering Materials). (Argonne National Lab., Ill.). (CAPE–1583).
826 drawings.

The extracted beam of ions from the ANL 60-in. cyclotron has a total energy of ~1%. An analyzing system capable of reducing the spread to the lowest feasible value is described. The analyzing system consists of magnets and ancillary hardware which obtain an energy resolution (full width at half maximum FWHM) of $\Delta E/E = 0.08\%$ for alphas of 43.2 MeV. (For details see TID-4100 Suppl. 40.) (F.S.)

34388 CONFINED INDIUM SEAL (Engineering Materials). (Stanford Linear Accelerator Center, Calif.). (CAPE–1586).
1 drawing.

A reusable noncreep indium seal is described which is used as a valve seat in a vacuum system in which rf power is being conducted. The seal is fabricated by hydraulically confining a soft metal sealing material, e.g., indium, in a groove. With a sealing force of ~400 lbs/in., a leak rate of less than 1×10^{-8} std atm cc/sec of He was realized. (For details see TID–4100 Suppl. 41.) (F.S.)

34389 NATIONAL PHYSICAL LABORATORY REPORT FOR 1966. Teddington, Eng., Ministry of Technology. 230p. HMSO 21s.

The measurement of the charge to mass ratio of the proton, interferometry and seismology with gas lasers, dosimetry, radioactivity measurements and standards, radiocarbon dating, thermodynamic properties of inorganic compounds, nuclear magnetic resonance of solids, purity determinations by mass spectroscopy, electron spin resonance in study of crystallization of glasses, electron probe microanalysis, instrumentation and application of electron nuclear double resonance, atomic vibrations in glass are discussed. Papers published by the Staff are listed. (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 34369, 34406, and 35701.

34390 (AE–286) CALCULATION OF STEAM VOLUME FRACTION IN SUBCOOLED BOILING. Rouhani, S. Z. (Aktiebolaget Atomenergi, Stockholm (Sweden)). June 1967. 30p. Dep.

An analysis of subcooled boiling is presented. It is assumed that heat is removed by vapor generation, heating of the liquid that replaces the detached bubbles, and to some extent by single phase heat transfer. Two regions of subcooled boiling are considered and a criterion is provided for obtaining the limiting value of subcooling between the two regions. Condensation of vapor in the subcooled liquid is analyzed and the relative velocity of vapor with respect to the liquid is neglected in these regions. The theoretical arguments result in some equations for the calculation of steam volume fraction and true liquid subcooling. (auth)

34391 (AECL–2681) AN ANALYTICAL MODEL FOR THE PREDICTION OF HYDRODYNAMIC INSTABILITY IN PARALLEL HEATED CHANNELS. Carver, M. B. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Mar. 1967. 32p. Dep. CFSTI. CAN $1.00.

The development of an analytical model for use on a digital computer investigating the phenomenon of flow instability in parallel heated channels is presented. Predictions of the threshold of instability given by the model are compared to parallel channel experiments at AECL. Good agreement was found, particularly at high pressures. (auth)

34392 (EURAEC–1811) UNTERSUCHUNG DER KRITISCHEN HEIZFLAECHENBELASTUNG (BURNOUT) BEI SIEDENDEM WASSER. (Investigations Into the Critical Heat Flux in Boiling). Report No. 09.03.01. Final Report. Mayinger, F.; Schad, O.; Weiss, E. (Maschinenfabrik Augsburg-Nuernberg A. G., Nuremberg (West Germany)). May 20, 1966. Contract 057-61-RDD. 359p. (EUR–3347). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The measurement of the critical heat flux on burnout in boiling, the inlet conditions, the L/D ratio of the test channel on nucleate boiling, and the inception of film boiling were investigated. The tests were made at pressures of 70 to 140 kgf/cm² using internally cooled tubes with diameters varying from 0.7 to 1.5 cm. The conditions at the test channel inlets covered mass flows between 100 and 350 g/cm² between a degree of sub-cooling of 20% and 20% steam quality. Two types of burnout were deserved: pulsating burnout, which has fluctuations in the pressure and mass flow shortly before film boiling starts; and burnout, which is hydrodynamically completely stable until film boiling suddenly occurs. Pulsating burnout observed in the sub-cooled boiling range was found to lead to critical heat flux levels 20 to 50% below those obtained with hydrodynamically stable flow. By varying the hydrodynamic inlet conditions on hydrodynamically stable burnout, it was possible to increase the critical heat flux up to 80%. Also, with very short test sections having an L/D ratio of 5 to 10 the critical heat flux is 4 to 5 times the value obtainable with long test channels having an L/D ratio of 80 to 100. For the pulsating burnout it was found that the existence of spaces filled with a compressible medium upstream of the test channel and throttling of the flow at the test channel inlet effect the pulsations. Therefore, throttling has proven to be a reliable, if uneconomical, means to avoid pulsating burnout. (D.C.C.)

34393 (LA-DC–8595) SIMILARITY OF FLOW OSCILLATIONS INDUCED BY HEAT TRANSFER IN CRYOGENIC SYSTEMS. Edeskuty, F. J.; Thurston, R. S. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-26. 22p. (CONF-670912–1). Dep. CFSTI.

From Symposium on the Dynamics of Two Phase Flow, Eindhoven, Netherlands.

Flow oscillations at acoustic frequencies are often observed during forced convection heat transfer to cryogenic liquids. These phenomena have occurred in two-phase flow and at supercritical pressures when the fluid undergoes a large change in density similar to a phase change. It has been postulated that the oscillations are generated during film boiling by the thermal response of the vapor film to flow disturbances. Disturbances which can be reinforced by a mechanism such as acoustic resonance become dominant in the system. Observed frequencies have been related to the harmonics of a pipe open at both ends and to Helmholtz resonance. An empirical correlation of oscillation inception conditions was previously published for liquid hydrogen in a $\frac{1}{4}$-in. ID electrically heated tube. Through the use of dimensionless similarity numbers, this correlation is shown to apply to new data on liquid nitrogen and liquid hydrogen in $\frac{1}{4}$-in. ID and 4-in. ID systems. The 16 fold geometrical scaling verified the suitability of applying the oscillation inception criterion to avoid oscillations in a water to liquid hydrogen heat exchanger which serves as an energy source for a turbopump used during nuclear rocket engine tests. (auth)

34394 (NAA-SR–12411) ANALOG COMPUTER STUDY OF THE DYNAMICS OF THE MRP COMBINED ROTATING UNIT SHAFT-BEARING SYSTEM. Hydrostatic Force Improvement. Terris, David (Atomics International, Canoga Park, Calif.). June 29, 1967. Contract AT(04-3)-701. 68p. Dep. CFSTI.

A study of the bearing and shaft dynamics of the Mercury Rankine Program's combined rotating unit (CRU V) is presented. The analog computer simulation of this high speed machine containing mercury lubricated bearings has been extended and improved. The primary achievement of this phase of the study is the successful incorporation of a more sophisticated and realistic representation of the bearing hydrostatic force over that presented in the reference. This hydrostatic force representation fully considers pressure drops through the compensating orifices, including inertial pressure drops under dynamic loading conditions. The results confirm the hypothesis that these inertial pressure drops through the orifices have an important influence on the bearing phase angle vs speed characteristic. This inertia effect also provides bearing stability under conditions of dynamic loading, so orifice flow inertia must not be neglected in the analysis of high speed bearings. The basis for the formulation of the improved hydrostatic force model is an equivalent electrical circuit representation for the bearing. The results justify the successful application of this analytical technique. The quantitative results show discrepancies with the comparable test data which are attributable to an inade-

quacy in the hydrodynamic force representation. The model shows too little hydrodynamic action at high speeds, yielding results which show less bearing stiffness compared to actual bearing test data. (auth)

34395 (NYO-3304-10) INVESTIGATION OF BOILING FLOW REGIMES AND CRITICAL HEAT FLUX. Quarterly Progress Report, August 1, 1966-March 15, 1967. Report No. 724. Bergles, A. E.; Roos, J. P.; Bourne, J. G. (Dynatech Corp., Cambridge, Mass.). June 21, 1967. Contract AT(30-1)-3304. 35p. Dep. CFSTI.

A detailed survey of reported experiments utilizing two-phase steam-water mixtures at the test-section inlet is presented. It is concluded that upstream and inlet-mixing instabilities must be avoided if the data are to be reliable. An annular inlet-mixing arrangement appears to yield critical heat flux data which are in close agreement with subcooled-inlet data, providing that the total test-section length is sufficiently long. The results of present tests utilizing a controllable annular mixer and a 0.4-in. diameter, 59-in. long test section, can be summarized as follows: adiabatic flow regime maps differ substantially from diabatic flow regime maps; however, in the adiabatic case, the entering phase distribution is of critical importance in determining what the flow regime will be at the test-section exit; for minimum flow pattern distortion, the steam and water feed flows must be close to the saturation condition; flow-regime and film-thickness measurements indicate that the entering water velocity must be controlled to establish a flow pattern comparable to that which would exist if subcooled inlet conditions were used; and film flow rate and critical heat flux behavior for mixed-inlet conditions appear to be comparable to that observed for subcooled inlet conditions if the mixer is properly adjusted. (auth)

34396 (RPI-3639-3) FLUID-PARTICLE HEAT TRANSFER COEFFICIENTS IN PACKED AND FLUIDIZED BEDS: A COMPARISON OF THE USE OF PERIODIC AND NON-PERIODIC INPUTS. Healy, John Edward (Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry). May 1967. Contract AT-(30-1)-3639. 125p. Dep. CFSTI.

Thesis.

The use of pulse and step temperature inputs to obtain the frequency response of packed and fluidized beds was investigated in studying fluid-particle heat transfer in these systems. Packed and fluidized beds of copper and glass particles were studied using air as the fluid. For the glass particles, flow rates up to 4 times the minimum fluidizing velocity were investigated. A 2-inch diameter column was used, and data were taken over the particle Reynolds number range of 4 to 55. The agreement in the results from periodic, pulse, and step testing was generally found to be good, with the exception of the regions where the frequency content of the pulse or step is small (high frequency and/or low amplitude ratio). The steady-state periodic method was found to have superior accuracy in the high frequency range, while the step is best used at very low frequencies. At intermediate frequencies all three inputs produced comparable results. Most of the copper particle bed data had previously been fitted to models and no further analysis was necessary. The frequency response data obtained for the glass particle fluidized beds at velocities up to 4 times above the minimum fluidizing velocity did not fit any of the existing models. However, the data were fitted approximately to the conduction-dispersion model of Barile to determine the order of magnitude of the parameters of the model. The heat transfer coefficient and solid phase conduction parameters were as expected, but the gas phase dispersion parameter was large, indicating that the bubbles cause a dispersion effect. The frequency response data for the glass particle fluidized beds was converted to a form showing the time response to a unit rectangular step input. On this basis it was compared to the data of Wamsley and Johanson and shown to be consistent with it. The glass particle beds do not follow the infinite mixing model. The frequency response data clearly show this, particularly the amplitude ratio data, which are much too high and indicate a kind of gas dispersion effect. (auth)

34397 (SAN-677-11) INVESTIGATION OF FUNDAMENTAL MECHANISMS AND PARAMETERS THAT INFLUENCE STEADY STATE AND TRANSIENT PERFORMANCE OF RANKINE CYCLE LIQUID METAL SYSTEMS. Quarterly Report, January 1-March 31, 1967. Poppendiek, H. F.; Feigenbutz, L. V.; Greene, N. D.; Sabin, C. M. (Geoscience Ltd., Solana Beach, Calif.). Contract AT(04-3)-677. 49p. Dep. CFSTI.

A mathematical study of the dynamics of an oscillating droplet above a hot surface and in the film boiling state is presented; equations for the velocity, period and amplitude are derived. A derivation is presented of the surface evaporation rate of a droplet that impinges on a hot surface making direct contact with the surface; typical results are presented for mercury. Results of an investigation of the influence of oxide films and different degrees of surface roughness on the vaporization lifetimes of mercury droplets on a Croloy 9M surface are presented. Oxide films of intermediate thickness and increases in surface roughness greatly decrease the vaporization lifetimes. A chemical reaction between saturated liquid mercury, superheated mercury vapor and thin oxide films was observed and found to enhance significantly the boiling heat transfer. Experimental droplet vaporization lifetimes are compared to bounding analytical expressions. Nonboiling forced flow mercury heat transfer experiments were completed (final system verification) in preparation for the boiling experiments with the Croloy 9M, Haynes 25 and columbium test sections. (auth)

34398 (SC-CR-67-2573) THEORETICAL STUDIES OF THE RE-ENTRY OF PLUTONIUM FUEL. Gilbert, L. M.; Liner, R.; Scala, S. M.; Schuyler, F. L. (General Electric Co., Philadelphia, Pa. Missile and Space Div.). June 1967. Contracts AT(29-1)-789; 48-4362. 130p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

The reentry response of small particles was calculated. The development of a theory for the melting of small particles under hypersonic reentry conditions and the development of analyses for predicting the stability of thin liquid layers on spheres and the conditions under which fully molten particles will break up are included. Based on these analyses, predictions of instability and mass loss were made for 50 and 250 micron diameter particles of plutonium dioxide for two specified release conditions. (auth)

34399 (UCID-15165) HEAT PIPE RADIATOR DESIGN. Space Power Note No. 214. Carlson, G. (California Univ., Livermore. Lawrence Radiation Lab.). June 15, 1967. Contract W-7405-eng-48. 49p. Dep. CFSTI.

The design of a heat pipe radiator for SPR-6 is presented. A wide range of parameters may be quickly evaluated through the use of the computer code HPRAD4. A "near-optimum" design yields a 46 Mw radiator with a mass of 12,000 kg. (auth)

34400 FORCED CONVECTION SUBCOOLED BOILING: PREDICTION OF VAPOR VOLUMETRIC FRACTION. Levy, S. (General Electric Co., San Jose, Calif.). Int. J. Heat Mass Transfer, 10: 951-65(July 1967).

A model is developed to predict the vapor volumetric fraction during forced convection subcooled boiling. The proposed method of calculation consists of three steps: the point of bubble departure from the heated surface (i.e., the location of vapor volumetric fractions significantly higher than zero) is determined from a bubble force balance and the single-phase liquid turbulent temperature distribution away from the heated wall; a relation is postulated between the true local vapor weight fraction and the corresponding thermal equilibrium value; and the vapor volumetric fraction is obtained from the true local vapor weight fraction and an accepted relationship between vapor weight and volumetric fractions. The method was applied to a variety of available test data, and the agreement was satisfactory for a multitude of flow, heat flux, and fluid property conditions. (auth) (UK)

34401 NEW METHOD FOR DETERMINING THE STAGNANT WAKE BEHIND A BODY. Baumgaertel, Guenter (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger. Technische Hochschule, Hanover). Brennst.-Waerme-Kraft, 19: 300-1(June 1967). (In German).

A new method is described for determining the stagnant wake behind bodies with a turbulent flow past them. The method relies on using radioactive Kr 85 as a tracer. The advantages of this method are compared with the disadvantages of older methods. (auth)

34402 DETERMINATION OF STEADY PARTIAL-LOAD DATA OF ONCE-THROUGH STEAM GENERATORS BY ANALOG-COMPUTATION. Schabrod, Konrad (Staatl. Ing.-Schule, Duesseldorf). Brennst.-Waerme-Kraft, 19: 293-6(June 1967). (In German).

For the critical investigation of steam generator behavior and dynamics many partial-load computations are often necessary. The determination of the temperature fields in the working fluids and in the construction elements leads to classical boundary-value problems; the iterative solving methods are known to be time consuming. If the solution is done by a digital computer, the examination of parameter variations is facilitated by direct plotting of the temperature fields. The use of an analog computer for the determination of partial-load steam generator data is explained. A once-through steam generator of a gas-cooled nuclear power station is used as an example. (auth)

34403 CHOKED-FLOW ANALOGY FOR VERY LOW QUALITY TWO-PHASE FLOWS. Hammitt, Frederick G.; Robinson,

M. John; Lafferty, J. F. (Univ. of Michigan, Ann Arbor). Nucl. Sci. Eng., 29: 131-42(July 1967).

Two theoretical models to predict axial pressure distribution, void fraction, and velocity in a cavitating venturi are applied. The theoretical predictions are compared with experimental data from cold-water and mercury tests, and good agreement for the pressure profiles is found. The predicted void fractions are found to be too high, probably because the models assume zero slip or negative slip between the vapor and liquid phases. The analogy between the cavitating venturi and other choked-flow regimes is explored. One of the theoretical models used is based on the assumption that the cavitating venturi is essentially entirely analogous to a deLaval nozzle operating in a chocked-flow regime with a compressible gas. The cavitating venturi is an example of an extremely low quality two-phase choked flow device. The present study is somewhat applicable to the study of liquid-cooled nuclear reactor pressure vessel or piping ruptures, which have received considerable attention in recent years. However, the qualities encountered in the present cavitation case are an order of magnitude lower than those usually considered for the reactor safety analyses, so that the present study is a limiting case for these. (auth)

Isotope Technology

Refer also to abstracts 34337 and 35779.

34404 (BNL-11512) CONCEPTUAL DESIGNS FOR HAWAIIAN IRRADIATOR AND QUARANTINE DEMONSTRATION IRRADIATORS. Manowitz, B.; Kuhl, O. A.; Oltmann, A. (Brookhaven National Lab., Upton, N. Y.); Armel, J.; Pignata, F. J. (Vitro Engineering Co., New York). Dec. 15, 1963. 51p. Dep. CFSTI.

The proposed Hawaiian Irradiator, and two pool-type and one dry unit quarantine demonstration irradiator are described. The Hawaiian Research Irradiator for irradiating fruits and vegetables would contain two 23⅛ in. high by 27½ in. long source plaques each containing 15,000 Ci of ^{60}Co. Auxiliary equipment would consist of a refrigeration unit and a packaged water treatment system. One of the pool-type irradiators has a ^{60}Co plaque positioned vertically in a rectangular well inset into the bottom plate of a cylindrical tank. The cylindrical portion of the tank is 12½ ft deep filled with water. The unit is underground and is designed for two-pass operation. The source is made up of seventy-five individual, double-encapsulated Brookhaven cobalt-60 strips. Two cobalt-60 source loadings are considered, one of 85,000 Ci and one of 425,000 Ci. The second pool irradiator uses an inclined tunnel rather than a vertical elevator, lead shielding is provided on the underside of the pool, multiple passes are employed to take advantage of "shine through," and "spent" source material is used with regular source material. Mechanical handling of food packages in the dry unit are the same as those used in the pool-type irradiator. The dry unit is also located underground. A shipping cask provides shielding above the source. The irradiator uses 50 Brookhaven source strips. (F.S.)

34405 (DP-1096) DEVELOPMENT OF ^{60}Co CAPSULES FOR HEAT SOURCES. Ross, Charles P.; Angerman, Carl L.; King, Franklin D. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). June 1967. Contract AT(07-2)-1. 49p. Dep. CFSTI.

Radioactive Co containing 100 curies of ^{60}Co per g of metal has been encapsulated in Inconel 600 and Hastelloy C containers. Such capsules, producing up to 250 w, have been tested successfully at 850°C for 100 hr in air. Longer tests are under way. Preliminary tests indicate that TD Nickel (2% ThO_2-dispersed) and TD Ni-Cr (78 Ni-20 Cr) are also promising materials for encapsulation. About 8 megacuries of ^{60}Co at activities up to 400 Ci/g will be available for heat source development and demonstrations by May 1967. Progress is reported in the areas of ^{60}Co production, fuel form properties, capsule design, capsule material properties, and capsule fabrication and testing. (auth)

34406 (SC-CR-67-2583) INVESTIGATION OF THE ABLATION OF SMALL PARTICLES UPON SIMULATED RE-ENTRY. Final Report. Slattery, J. C.; Tagliaferri, E. (TRW Systems, Redondo Beach, Calif.). Feb. 1967. Contract 48-2673. 44p. Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

Results obtained from a research program on the behavior of small particles under conditions simulating reentry into the atmosphere are summarized. Using particles with diameters on the order of one micron, measurements were made of the heat transfer and drag coefficients of silver and iron particles interacting with target gases of air, argon, nitrogen, and oxygen. Measurements were made in the free molecule flow regime for nonablating iron and silver particles, and for ablating iron particles. Measurements were also made for iron particles in the transition flow regime using an air target. (auth)

34407 (SC-DC-67-1596) A MOBILE LASER TRANSCEIVER USED FOR DETECTING LONG RANGE, SLOW VELOCITY, AND LOW DENSITY TARGETS. Landry, M. J.; Lochner, J. R. (Sandia Corp., Albuquerque, N. Mex.). Apr. 1967. Contract AT(29-1)-789. 21p. (CONF-670716-1). Dep. CFSTI.

From 1st International Conference on Laser Applications and World Exhibition of Instruments and Laser Techniques, Paris, France.

Two mobile laser transceivers to detect artificial clouds comprised of ablative materials from SNAP reentry vehicles for use in aerospace nuclear safety are described. The transceivers consist of ruby laser transmitters, mobile receivers, photomultiplier tube detectors, oscilloscope camera timing generators for recording, and power supplies. Atmospheric clouds were detected at a 26 mile range at night and at 43.2 mile range in daytime. (F.S.)

34408 (SC-RR-66-2716) AERODYNAMIC BREAKUP OF LIQUID DROPS. Luna, R. E.; Klikoff, W. A. Jr. (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 45p. Dep. CFSTI.

A survey of the liferature on the breakup of liquid drops under aerodynamic loading, vital to the safety assessment of the space application of systems for nuclear auxiliary power, was made. Parameters most appropriate for characterizing the breakup process were determined. The Weber number was found to be the best means for estimating breakup potential of a liquid drop. Weber numbers between 1 and 10 are used for incipient breakup of low-viscosity liquids. Numbers up to 30 may be appropriate for high-viscosity liquids. Ohnesorge numbers are used to measure the influence of viscosity. For Ohnesorge numbers less than 1, viscous effects are secondary. For numbers greater than 1, the effect of viscosity is to increase the value of the critical Weber number for breakup. (F.S.)

34409 DESIGN AND USAGE OF A ^{137}Cs GAMMA IRRADIATOR FOR BREEDING AND PHYSIOLOGICAL STUDIES. Patrick, Homer; Emerson, R. E.; Hyre, H. M. (West Virginia Univ., Morgantown). W. Va., Univ. Agr. Exp. Sta., Bull., No. 518T, 11p(Dec. 1965).

The design of a 300-Ci ^{137}Cs γ irradiation facility and its use for agricultural studies are described. Construction of the irradiator assembly, which consists of 3 main parts, the building, a well, and irradiation tables, is outlined. The extent to which irradiation decreased the spleen weight of chicks 21 days old and of 200-g rats, effects on serum phosphatase level in chicks, and the amount of irradiation required to reduce fertility 50% in breeding hens inseminated with irradiated sperm, are shown. The data on the influence of γ irradiation on spleen weight, serum alkaline phosphatase, and ^{75}Se retention of cockerels 3 weeks of age demonstrate that this irradiator, which allows many groups of animals and different dose rates to be used, can produce consistent data. Some advantages of this irradiator over some existing units are discussed. The ^{137}Cs has a half-life of more than 30 yr as compared to ^{60}Co with a half-life of 5.27 yr, thus allowing seasonal studies to be made without large changes in irradiation dose rates. Many levels of irradiation can be obtained at one setting, yet a uniform dose is given to each specimen. (BBB)

34410 APPLICATION OF RADIOISOTOPES AND RADIATION TO THE EVALUATION AND CONTROL OF DAIRY-FOOD PROCESSES. Harper, W. J.; Gould, I. A. (Ohio State Univ., Columbus). pp 15-28 of STI/PUB-135.

The utilization of radioisotopes as a means of measuring and controlling manufacturing processes of the dairy industry has definite advantages from the standpoint of continuous monitoring, external mounting, improved precision, accuracy of measurement, and continuous control. Among the commercial applications of radioisotopes by the dairy industry discussed are density determinations of products with the resulting control of vacuum pan operations; control of air incorporation in products; package fill control and inspection; the detection of defects in processing equipment; corrosion detection; and quality control. (C.H.)

34411 UTILIZATION OF RADIOACTIVE ISOTOPES AS TRACERS IN RESEARCH CONCERNING MILK AND MILK PRODUCTS. Harper, W. J.; Gould, I. A. (Ohio Agricultural Research and Development Center [Wooster]. pp 51-64 of STI/PUB-135.

A variety of radioisotopes have been used as tracers in research on the synthesis of milk and milk components. A brief review of some of the major findings is presented. In addition, results are presented of recent research in order to illustrate various applications that can be made of a single isotope in studying the chemistry and biochemistry of milk and milk products. (auth)

34412 DETERMINATION OF THE PERMEABILITY OF SOIL STRATA BY MEANS OF A RADIOACTIVE ISOTOPE AT THE EL-BAKRA OIL FIELD. Etman, M. H. (Atomic Energy Establishment, Cairo); Varga, K. Energ. Atomtech., 19: 492-3(Oct. 1966). (In Hungarian).

The permeability of oil-storage strata in deep wells at the El-Bakra fields of the United Arab Republic was determined by means of a special tracer technique. As the highly permeable layers accept larger amounts of the radioactive liquid than the less permeable ones, when the pressure is released, backflow is observed. By means of γ logging it was found possible to determine the exact location and the rate of this backflow. The tests were carried out with 100 mCi of ^{51}Cr adsorbed on 100 g of an ion exchange resin, mixing the labeled resin in 30 m^3 of seawater. The results revealed that the zone from 1001 to 1022 m has low permeability; the 1022 to 1037 m zone is completely impermeable; from 1037 to 1052 m, the zone is not perforated The method is suitable for the detailed determination of the permeability of oil field soil strata, yielding data that may be used to increase the productivity of the field. (TTT)

34413 NEUTRON SOURCES. Fridrich, Bedrich (Inst. for Research, Production, and Uses of Radioisotopes, Prague). Jad. Energ., 13: 205-11(June 1967). (In Czech).

The more interesting features of the development of new types of neutron sources and of the latest experimental results in the uses of the radioactive sources at The Institute for Research, Production and Uses of Radioisotopes, Prague, are surveyed. (auth)

34414 ISOTOPIC TREATMENT PROCESS. (to Compagnie Generale d'Electricite). British Patent 1,074,710. July 5, 1967. Priority date Oct. 21, 1963, France.

Equipment and procedures used in separating gaseous mixtures containing two isotopic compounds are described. One of the compounds must have a first excitation potential which is lower than the excitation potential of the second compound. The mixture is subjected to radiation with a spectrum showing a line narrow enough for exciting only one compound while molecules of the other compound remain at ground state. A second radiation with a shorter wavelength is used to excite the molecules in the second compound. The first radiation may be in the infrared band and the second in the ultraviolet band. This separation method may be used in the separation of ^{235}U and ^{238}U from gaseous UF_6. (F.S.)

34415 IRRADIATION PLANT. (to Sulzer Brothers Ltd.). British Patent 1,075,330. July 12, 1967. Priority date Mar. 11, 1965, Switzerland.

An irradiation facility is described which has at least two source passages for radiation sources. Distribution passages are arranged at one end to communicate with the source passage and at the other end with a rotatably mounted distribution valve. The distribution valve has a passage terminating at one end on the axis of rotation of the valve and the other end eccentric to the axis and positioned to communicate with the other ends of the distribution passages on rotation of the valve. Radiation sources are changed using a source carrier. A locking system prevents the source carrier from being connected or removed from the valve unless the valve is closed. (F.S.)

34416 RADIOACTIVE CERAMIC SOURCE AND METHOD OF MANUFACTURE. Meyer, Gerard; Michel, Andre (to CEA). British Patent 1,076,335. July 19, 1967. Priority date Oct. 29, 1964, France.

A radioactive ceramic source which can be employed as a heat source in an electrical energy generation is manufactured using ^{90}Sr as the source material with a base of strontium fluorapatite. In preparing the source, the strontium fluorapatite is crushed to a particle size smaller than 50μ. The crushed product is shaped in an organic binder which disappears on heating. The compacting pressure is 3 tons/cm^2. After compacting the shape is heat treated for 8 to 12 hrs at 800° to 1600°C to form a very small dense source for spaceship use. (F.S.)

Materials Testing

Refer also to abstracts 34365, 34880, 34882, and 34896.

34417 (AECL-2704) HIGH RESOLUTION AUTORADIOGRAPHY. Ploc, R. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). June 1967. 13p. Dep. CFSTI. CAN $0.50.

An assessment of high-resolution autoradiographic techniques showed that the location of radioactive sources to within 500 to 600 Å should be possible, for certain metallurgical applications. These applications might include the location of impurity atom clusters at grain boundaries or dislocations; the location of precipitates of substances that have atomic numbers similar to that of the matrix; the identification of diffusion paths; preferential absorption or adsorption; segregation of impurities; and the role of specific ions in phenomena such as stress corrosion (e.g., the segregation of hydrogen at crack tips), or fatigue. (auth)

34418 (LA-DC-8846) CRYOGENIC VALVE TESTING. Johnson, Evan R. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 7p. (CONF-670903-5). Dep. CFSTI.

From 22nd Instrument-Automation Conference and Exhibit, Chicago, Ill.

The results of testing cryogenic valves in the nuclear rocket development program are presented. This program uses cryogenic valves in sizes up to 16", with working pressures to 2160 psig, and temperatures as low as −423°F. (auth)

34419 (TRG-Report-1404, Paper 8) DEVELOPMENT OF TENSILE CREEP IRRADIATION EQUIPMENT. Catling, E.; Wallace, F. G. 13p.

Information on investigations associated with the in-pile measurement of creep specimen expansion is presented. The design and development of equipment for two series of experiments is described. (auth)

34420 A COMPARISON OF THEORETICAL AND EXPERIMENTAL RESULTS FROM SPHERICAL SHELLS WITH A SINGLE RADIALLY ATTACHED NOZZLE. Witt, F. J. (Oak Ridge National Lab., Tenn.); Gwaltney, R. C.; Maxwell, R. L.; Holland, R. W. Trans. ASME (Amer. Soc. Mech. Eng.), Ser. A J. Eng. Power, 89: 333-40(July 1967).

A series of steel models having single nozzles radially and nonradially attached to a spherical shell is presently being examined by means of strain gages. Parameters being studied are nozzle dimensions, length of internal nozzle protrusions, and angles of attachment. The loads are internal pressure and axial thrust and moment loadings on the nozzle. Both experimental and theoretical results are presented from six of the configurations having radially attached nozzles for which the sphere dimensions are equal and the outside diameter of the attached nozzle is constant. In some instances the nozzle protrudes through the vessel. (auth)

34421 COMPARISON OF MEASURED AND CALCULATED STRESSES IN PRESSURE VESSELS. Kraus, H. (State Univ. of New York, Stony Brook). Trans. ASME (Amer. Soc. Mech. Eng.), Ser. A J. Eng. Power, 89: 341-4(July 1967).

Stresses as calculated by two available computer programs for the analysis of pressure vessels are compared to photoelastic data obtained for a series of pressure vessels with hemispherical and torispherical heads. One program is based upon Love's first approximation to the theory of thin elastic shells, and the other is based upon a higher-order theory of shells. The comparison shows that programs based on either theory can be used with equal confidence in the calculation of stresses in pressure vessels. (auth)

34422 LOW CYCLE FATIGUE BEHAVIOR OF DISSIMILAR WELDS. Wylie, R. D.; Watson, P. D. (Southwest Research Inst., San Antonio). Trans. ASME (Amer. Soc. Mech. Eng.), Ser. A J. Eng. Power, 89: 353-9(July 1967).

The use of large-diameter vessels constructed of ferritic steels with austenitic stainless steel cladding joined to stainless-steel primary piping material may create a safety problem at the dissimilar weld. Consideration has been given by several investigators to the performance of weld joints between austenitic and ferritic steels at temperatures of 1000 to 1100 deg F. These investigators attributed failures which occurred in dissimilar weld joints at this temperature to the shear stresses developed during thermal cycling resulting from the differential coefficient of thermal expansion, as well as to the widely different mechanical properties and environmental resistance of the two materials at operating temperature. The operating conditions in a water-moderated nuclear power plant are considerably different from those cases reported in the literature. The temperature ranges from 500 to 600 deg F and the stresses are higher, consistent with the increased allowable stresses at the lower temperature. To investigate the failure performance of dissimilar welds under the conditions expected in such service, two programs were conducted. Part of a continuing program to investigate the effects of radiation on such welds is submitted. Tests were made on specimens and on nozzles simulating the construction details observed in nuclear vessels. The design, fabrication, and fatigue performance of such welds are presented. (auth)

34423 THE EFFECT OF NOZZLE SPACING ON THE PRESSURE STRESSES AT THE INTERSECTION OF CYLINDRICAL NOZZLES AND SHELLS. Stone, R. M. (Combustion Engineering, Inc., Chattanooga); Hochschild, S. Trans. ASME (Amer. Soc. Mech. Eng.), Ser. A J. Eng. Power, 89: 360-8(July 1967).

The effect of nozzle spacing on the pressure stresses of cylin-

drical pressure vessel shell and nozzle junctures is presented. This consideration is based on a photoelastic test conducted to determine if the stress indices of Section III of the ASME Boiler and Pressure Vessel Code may be used in analysis of reactor vessel designs containing circumferential nozzle spacings smaller than presently allowed by the Code. The five circumferential spacings used in the test were 109 deg, 34 deg, 30.2 deg, 26.4 deg, and 22.5 deg. The stresses at the locations of interest are presented as a function of nozzle spacing. These results show that the maximum stresses for spacings below the Code minimum are smaller than those at the Code minimum. (auth)

34424 THE DETERMINATION OF THERMAL DIFFUSIVITIES OF THERMAL ENERGY STORAGE MATERIALS. PART I. SOLIDS UP TO MELTING POINT. Chang, H. (Nuclear Materials and Equipment Co., Apollo, Pa.); Altman, M.; Sharma, R. Trans. ASME (Amer. Soc. Mech. Eng.), Ser. A J. Eng. Power, 89: 407-14(July 1967).

A method for the determination of thermal diffusivities which has been developed specifically for substances which are poor conductors and which have high melting points is presented. Materials which are useful for thermal energy storage fall into this category. The method has several unique features. The basic principle involved consists of raising the surface temperature of a solid specimen at a uniform rate. After the initial transients have died out, the diffusivity can be determined from temperature measurements alone. The advantages of the method are: heat flux measurements are not needed; materials can be tested right up to the melting point, since the specimens can be encapsulated and softening can be tolerated; large temperature ranges can be tested quickly; and precision and accuracy are good. Results of measurements are reported for alumina and lithium fluoride. (auth)

34425 RADIOGRAPHIC SENSITIVITY. Stevens, Arthur J. (Radionics, Inc., Norristown, Pa.). Mater. Eval., 25: 169-72 (July 1967).

Radiographic sensitivity is defined, and a mathematical expression describing it is derived. Evidence is presented that radiographic sensitivity, contrary to popular opinion, is independent of specimen thickness per se, and that modern penetrameter design is based on invalid assumptions. Designs for penetrameters are offered that provide a more realistic measure of the quality of a radiographer's techniques. (auth)

34426 IMPROVEMENTS IN AND RELATING TO APPARATUS FOR TESTING CONCRETE. Blatzeim, Roger; Bonvalet, Charles; Marechal, Jean-Christian; Dubois, Frederick (to CEA). British Patent 1,074,352. July 5, 1967. Priority date Mar. 19, 1965, France.

A test device is described which is used to determine the mechanical characteristics of concrete test pieces when subjected to thermal gradients. The concrete may be prestressed for use as shielding for nuclear reactors. Test pieces are heated on one side by heating elements; the other side is washed with a flow of air at controlled temperatures. At least one hydraulic jack is used to load the test piece to compensate for sag, and at least one sensing element is used to measure the sag and to control the jack. (F.S.)

Protective Structures

Refer to abstract 34659.

Radioactive Material Handling

Refer also to abstracts 34289, 34331, 34375, 34376, 34381, and 34974.

34427 (BNWL-SA-815) CRITICALITY SAFETY IN TRANSPORTATION AND STORAGE. Brown, C. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [nd]. Contract AT(45-1)-1830. 38p. (CONF-661206-5). Dep. CFSTI.

From American Nuclear Society, National Topical Meeting, Nuclear Criticality Safety, Las Vegas, Nev.

The safe transportation and storage of fissile material is described. Accomplishments during 1966 and their effects on the transportation outlook, the status of existing shipping packages under revised regulations, the basis for the criticality safety evaluation, and calculational methods and the possible need for improving and standardizing these methods are discussed. The storage of fissile material is also discussed. It was concluded that in order to lower transportation costs, improved shipping container designs with higher capacities and improved methods for criticality assessment are needed. (D.C.C.)

34428 (ORNL-TM-1832) THE DISPOSAL OF RADIOACTIVE LIQUID AND GASEOUS WASTE AT OAK RIDGE NATIONAL LABORATORY, DECEMBER 1966. Manneschmidt, J. F.; Witkowski, E. J. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 53p. Dep. CFSTI.

The ORNL radioactive waste disposal systems are described. The growth of the Laboratory has extended the waste disposal systems and the accompanying monitoring nets to the new facilities in Melton Valley. The whole concept of intermediate-level waste disposal has changed with the elimination of soil disposal pits and trenches in favor of deep-well injection of an evaporator concentrate. Increased demand on the systems has resulted in continual upgrading and replacement of equipment and changes in operating procedure. The significant changes in the area of waste disposal at ORNL during the past few years are discussed. (auth)

34429 (TID-23865) PM-1 RADIOACTIVE WASTE DISPOSAL SYSTEM HAZARDS ANALYSIS ADDENDUM. [Freedman, M. B.] (AMF Atomics, York, Pa.). May 1967. Contract AT(30-1)-3419. 53p. Dep. CFSTI.

An evaporative type subsystem for the disposal of liquid wastes from various points in the PM-1 Plant is described. The major portion of the system is installed at grade elevation. To receive the normal waste, a sump tank, located below grade elevation, receives the liquid waste by gravity and automatically pumps it into the Radioactive Waste Disposal System (RWDS) hold tank. The majority of the waste generated will be radioactive in the order of 10^{-2} μCi/cc. Where high activity levels are expected, such as in the processing of fuel defect wastes, primary coolant resins, and decontamination waste, the shipping containers will be placed within a portable shield while processing and storing these wastes. A portable shield has been designed to handle up to 2.3 Ci of one MeV gammas with an estimated surface contact dose rate of 5 mr/hr. The subsystem operation is based on the closed-loop, recycling-evaporation, Ray-Di-Pak process. The functions of the subsystem are to collect, concentrate, and store in a safe manner all radioactive liquid wastes resulting from normal plant operation, as well as those resulting from a major decontamination of the primary loop. (D.C.C.)

34430 SOLIDIFICATION OF HIGH-LEVEL RADIOACTIVE WASTES. PART 3. THE DIFFUSION AND ELUTION RATES OF RADIONUCLIDES INCORPORATED IN BASALTS. Ralkova, J.; Saidl, J. (Institut fuer Kernforschung, Prague). Kernenergie, 10: 161-4(May 1967). (In German).

The safe retention of high-level radioactive wastes and the removal of the incorporated nuclides was studied. The diffusion and elution of ^{137}Cs and ^{90}Sr in glass and in molten basalt were investigated. The diffusion coefficients obtained are sufficiently low for accomplishing the legal requirements on observing the maximum permissible concentrations of activity in contact with water. (auth)

Vacuum Engineering

Refer also to abstracts 34539 and 34543.

34431 WINDOW SEALS FOR ULTRAHIGH VACUUM USE. Roberts, R. W.; Harrod, J. F.; Poran, H. A. (General Electric Co., Schenectady, N. Y.). Rev. Sci. Instrum., 38: 1105-7(Aug. 1967).

Sealing techniques are described for joining windows of lithium fluoride, magnesium oxide, and quartz to Pyrex glass, FN glass, quartz, and silver. These seals withstand repeated bakeouts at 300 to 350°C and can be used in ultrahigh vacuum systems. (auth)

34432 EVAPORATION APPARATUS WITH AN AUTOMATIC PUMPING CYCLE FREELY FUNCTIONING FOR USE IN HIGH OR ULTRAHIGH VACUUM. Reisinger, H. (Balzers AG, Liechtenstein). Vide, 22: 95-8(Mar.-Apr. 1967). (In French).

A UHV coater with by-pass is described, which reaches ultimate pressures of 10^{-6} torr with Viton seals, only having to be moderately heated once in 24 hours (overnight). In this way, reproducible conditions are obtainable in the industrial production of thin films. The same coater reaches pressures in the low 10^{-7} range, being moderately baked before every charge. Without by-pass and using metal seals on the bell jar and baking to 450°C, the ultimate pressure is in the region of 10^{-12} torr. (auth)

34433 ISOEPITAXY OF SILICON BY THERMAL EVAPORATION UNDER ULTRAHIGH VACUUM. Constantin, C. (Lignes Telegraphiques et Telephoniques, Conflans-Sainte-Honorine, France); Cinti, R.; Montmory, R. Vide, 22: 105-9(Mar.-Apr. 1967). (In French).

Single crystal films of silicon were obtained by evaporation in ultrahigh vacuum onto single crystal silicon substrates. The silicon source material is evaporated by electron bombardment with

an electron gun of 10 kW maximum power, from a series of five water cooled OFHC copper crucibles. The substrate is induction heated. Several different oven designs were used. The rate of evaporation varies between 170 and 3,500 Å/min. The pressure before evaporation begins is between 5×10^{-10}-5×10^{-9} torr. The film structures have been examined by reflection electron diffraction, and by X-ray diffraction with the Laue technique. The substrate temperatures employed range from 1,200°C to below 600°C, at which temperature the films are still single crystals. The precise temperature at which polycrystallinity is observed is being studied. Both p and n-type films from high resistivity silicon as well as from material doped with arsenic, phosphorus, or antimony were deposited. The first films were all p-type, with a carrier concentration of between 10^{17} and 10^{18}/cm^3. Improvements in the vacuum system permitted us to obtain n-type films with resistivities between 0.30 and 3 Ω.cm. Samples are presently being prepared for fabricating diodes and transistors. The epitaxial growth at low temperatures should minimize the diffusion at the interfaces, and obtain sharp junctions. (auth)

34434 ULTRAHIGH VACUUM EVAPORATORS FOR DEVELOPMENT OF ACTIVE SEMICONDUCTOR ELEMENTS CONSTRUCTED ACCORDING TO IONIC PUMPING TECHNIQUES. Varon, A.; Desforges, M. (RIBER, Rueil-Malmaison, France). Vide, 22: 110-14(Mar.-Apr. 1967). (In French).

Ultra-high vacuum pumping techniques, based on the combination of three physico-chemical processes are described. A high pumping speed may maintain the ultrahigh vacuum during evaporation. Partial pressures were observed during evaporations with a Quadrupole Gas Analyzer. New techniques using the analyzer to study ion spectra originated from the evaporated products are presented. (auth)

34435 1965 TRANSACTIONS OF THE THIRD INTERNATIONAL VACUUM CONGRESS, 28 JUNE–2 JULY 1965, STUTTGART, GERMANY, VOLUME 2, PARTS I, II, AND III, SESSIONS 1–13. Adam, H. (ed.). New York, Pergamon Press, 1967. 780p. (CONF-650643–(Vol.2)).

Separate abstracts were prepared for 27 of the papers presented at this conference. Two papers have appeared previously in NSA. For abstracts of these see 19:44135 and 20:29600. The remaining papers contain information on evaporation of thin films, flow of gases, components and materials of vacuum pumps, adsorption and desorption, pressure measurement and leak detection, vacuum metallurgy, sputtering and gettering, cryogenics, and space simulation. (R.C.K.)

For abstracts of individual papers see: 34436–34461 and 34543.

34436 RESISTANCE MEASUREMENTS IN THE INCORPORATION OF VACUUM RESIDUAL GASES IN THE EVAPORATION OF THIN GOLD AND NICKEL LAYERS. Kadereit, H. G. (Siemens and Halske AG, Munich). pp 43-6 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967. (In German).
See CONF-650643–(Vol.2).

Gold and nickel films ranging from 600 Å to 10,000 Å in thickness were evaporated at different pressures in an ultrahigh vacuum apparatus, after admission of different gases. Measurements of residual resistivity on the films show that as the pressure rises in the vacuum vessel, foreign substances become increasingly entrapped in the samples. From the values found by extrapolation for the specific resistivity of 4.2°K on material extended to infinity, the adhesion coefficients can be estimated for different gases in the evaporation of gold and nickel. These coefficients may differ by orders of magnitude, becoming larger as the pressure drops in the vacuum vessel. The computation of the degree of contamination of evaporated gold and nickel films by residual gases in vacuum, by applying the laws of gas kinetics for the adhesion coefficient gives considerably larger gas concentrations than the experiment in the investigated pressure range. (auth)

34437 STUDY OF THERMAL TRANSPIRATION USING ULTRAHIGH VACUUM TECHNIQUES. Edmonds, T.; Hobson, J. P. (National Research Council, Ottawa). pp 75-8 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

The thermal transpiration ratio R, of helium and neon was studied between the temperatures 77.4°K, 232°K(T_1) and 295°K(T_2) over a pressure range from 10^{-3} torr to 60 torr. An absolute method was used with a series of geometries at the temperature interface—an aperture of diameter d = 20 mm and long tubes with d ranging from 2.1 mm to 19.0 mm. Pressures were low enough to ensure $d/\lambda \to 0$ (λ mean free path). For the aperture, $R_m = (T_1/T_2)^{\frac{1}{2}}$ was found at low pressures. It was not found for tubes. The failure of this limited law for tubes is discussed. In consequence the relative method for measuring R is unreliable at low pressures. The location and magnitude of the temperature gradient were found to vary with R in general. The data were compared with several analytic expressions. It was found that the equation of Liang described all data including those for tubes when the experimental limiting ratio was substituted for R_m. (auth)

34438 BEHAVIOR OF DIFFERENT IONIZATION GAGES AT VERY LOW PRESSURES. de Segovia, J. L.; Martin, C. S. (Centro de Investigaciones Fisicas L Torres Quevedo, Madrid). pp 245-9 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

The behavior of four different ionization gauges of Bayard-Alpert type was studied. These were the regular Bayard-Alpert gauge (BAG), modified Bayard-Alpert gauge (MG), Bayard-Alpert gauge with grid outgassed by ohmic heating (SBAG), and Schuemann's Supressor Gauge (SG). The gages were attached to an ultrahigh vacuum system to compare their readings at very low pressures. The MG gauge showed a very low x-ray limit which was revealed when the grid potential was increased. At low emission currents the BAG and MG gauges indicated pressures three and six times higher than the respective monitor gauge. The most important gas in the system was CO, as revealed by an Omegatron mass spectrometer. Ion currents due to surface ionization were observed with the MG gauge, even at 10 mA emission. (auth)

34439 EPITAXIAL GROWTH OF Si ON Si IN ULTRAHIGH VACUUM. Widmer, H. pp 309-11 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

Silicon has been evaporated in ultrahigh vacuum of about 10^{-10} torr, onto clean silicon substrates. The dependence of the growth on the temperature, orientation, and surface treatment has been studied. The deposits were evaluated by transmission electron microscopy and by transmission and reflection electron diffraction. For (111) substrates epitaxy has been observed at a substrate temperature of about 520°C and above. Below this temperature the deposit is either polycrystalline or amorphous. (auth)

34440 PREPARATION OF HIGH MOBILITY THIN FILMS OF INDIUM ANTIMONIDE. Juhasz, C.; Anderson, J. C. (Imperial Coll. of Science and Tech., London). pp 333-41 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

An investigation of the growth of thin films of indium antimonide for use in active devices has been made. Films have been grown by a variety of methods which range from atomic mixing to relatively coarse layering of the components on the substrate. These methods include the three temperature method and flash evaporation. Vacuum pressure has been varied from 10^{-6} to 10^{-9} torr. Substrates used have included mica, on which well-oriented films were produced, and SiO covered glass, on which polycrystalline films were obtained. Post growth recrystallization was carried out in every case by protecting the film with an evaporated overlayer of a suitable insulating material of BaF_2, CaF_2, MgF_2 and SiO. Room temperature mobilities of the order of 10^4 cm^2/volt sec have been obtained in well-oriented films and of $\sim 6 \times 10^3$ cm^2/volt sec in polycrystalline films. Carrier densities are in the region of 10^{16}/cm^3 and surface state densities around 5×10^{11}/cm^2. (auth)

34441 IMPACT ACTIVATED SORPTION AS A MEANS FOR GAS INCORPORATION IN SPUTTERED THIN FILMS. Kay, E.; Winters, H. F. (IBM Research Lab., San Jose, Calif.). pp 351-7 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

The effects of ion bombardment during film growth on the structural properties and gas content of sputtered nickel films have been investigated. A glow discharge apparatus designed to allow bombardment of the growing film with ions of known energy is described. The sticking probability of Ar^+ ions were determined as a function of ion energy and oxygen surface coverage for evaporated nickel films in a well-defined system. The ion induced re-emission of previously adsorbed argon was also studied as a function of ion energy. The results of these experiments are tentatively related to results obtained on films grown in the glow discharge sputtering experiment. (auth)

34442 AGGREGATION OF SILVER AND GOLD EVAPORATED LAYERS, WHICH WERE DEPOSITED ON CARBON FOILS AT HIGH TEMPERATURES IN AN ULTRAHIGH VACUUM. Hanszen, K. J. (Physikalisch-Technische Bundesanstalt, Brunswick). pp 363-5 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967. (In German).

See CONF-650643-(Vol.2).

Silver and gold films which were deposited on a number of carbon foils at elevated temperatures and at residual gas pressures of 10^{-4} to 10^{-9} torr consist of two superimposed layers of particles of distinctly different average sizes. At a condensation temperature of 100°C the film layer adjacent to the substrate consists of extremely small particles; for higher condensation temperatures, however, the particle sizes of this layer will increase considerably. The observed phenomenon is affected by the state of the condensation surface. (auth)

34443 DESIGN CONSIDERATIONS FOR VACUUM SYSTEMS WITH BUILT-IN GETTER ION AND SUBLIMATION PUMPS. Zaphiropoulos, R.; de Taddeo, D. (Varian SpA, Turin). pp 373-6 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.

See CONF-650643-(Vol.2).

A comparative design analysis is made for vacuum systems using diffusion pumps and getter ion pumps. The important elements in any vacuum system are the work chamber and the pumping means. The features of "parallel" and "series" pumping are compared. Different methods are discussed and illustrated for achieving "parallel" pumping on a work chamber by using cryopumps, sublimation pumps, mechanical pumps, and getter ion pump. The advantages of different configurations are described and typical pump-down curves for systems designed and built according to the "in parallel" principles, including "built-in" pumps, are given. The systems described have been used in thin film and environmental studies applications and can reach pressures in the low 10^{-11} torr range in 8 hrs. (auth)

34444 PULSED HIGH-FREQUENCY DISCHARGE AS GAS CIRCULATION PUMP. Eidmann, K.; Walcher, W.; Wiesemann, K. H. pp 397-402 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967. (In German).

See CONF-650643-(Vol.2).

A system is described for circulating pure gases; it can be baked out at up to 500°C, and does not appreciably contaminate the gases. It is used in an ultrahigh vacuum apparatus which permits pressures of down to several times 10^{-9} torr to be attained. In this system the gas is periodically heated by a pulsated electrodeless discharge. A two-way valve is controlled in proper phase relation with the heating. The valve consists of a slide on a leaf spring, which oscillates in front of two openings. The oscillation is induced magnetically from outside. The properties of the pump, i.e., compression ratio and pumping speed in relation to the energy absorbed by the discharge and to the pressure, can be calculated, by means of a model, from the time-dependent heat conduction equation. The measured data satisfactorily agree with the calculated values. The pump has a high pumping speed at a low compression ratio. For a working volume of 1 l, a compression ratio of between 1.02 and 1.003 was measured in the pressure range of 1 torr to 25 torr. In this range, the throughput is between 1 torr .l/s and 3 torr .l/s. The working range of the pump is limited by the operating conditions of the discharge, and is at least 10^{-3} torr to 25 torr for our system. (tr-auth)

34445 MODULATED MOLECULAR BEAM APPARATUS FOR STUDIES OF ATOMIC INTERACTIONS WITH SURFACES. Dalins, I. (Marshall Space Flight Center, Huntsville, Ala.). pp 425-9 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.

See CONF-650643-(Vol.2).

A reliable and compact modulated molecular beam apparatus of special design, predominantly of glass construction, suitable for ultrahigh vacuum operation in conjunction with field emission microscope has been designed, assembled and repeatedly operated, submersed in liquid nitrogen after being subject to as high as 20 hour bakeout at 450°C. The system is useful for studies of atomic adsorption, desorption, and surface migration phenomenon on wires or field emission microscope tips under controlled surface conditions in connection with certain applications in space technology (electric propulsion research, etc.). This particular design involves the use of a capillary tube in order to construct the flow of adsorbate atoms at the exit slit to an acceptable small value and specially designed magnetically driven chopper for beam modulation purposes. It has been found that the operation below the mechanical resonance of the chopper armature enables rather accurate control of the armature so that certain gating of the voltages applied to the field emission microscope is possible. The special design features of this instrumentation in comparison with similar earlier designs and its operation in ultrahigh vacuum are presented. (auth)

34446 CONTROLLED HYDROGEN PARTIAL PRESSURE IN A FIELD ION MICROSCOPE. Mueller, E. W.; Nakamura, S.; McLane, S. B.; Nishikawa, O. (Pennsylvania State Univ., University Park). pp 431-9 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.

See CONF-650643-(Vol.2).

Achievement of atomic resolution in the field ion microscope depends upon the accommodation of helium atoms from above 1000°K to 21°K, which the field trapped gas atoms obtain only after several hundred contacts with the cold tip surface because of the small accommodation coefficient. Addition of hydrogen or deuterium to the image gas so efficiently increases the accommodation coefficient of helium that the ionization field can be reduced from a typical 450 MV/cm to 320 MV/cm. Hydrogen promotion of field evaporation also reduces the field required for shaping the tip surface to atomic perfection. Utilizing both effects signifies a breakthrough in field ion microscopy of the common transition metals such as Fe or Ni which could not stand the high field stress required before. In practice an effective control of the hydrogen addition is required to achieve surface stability. A heated zirconium foil is used to reversibly control the hydrogen or deuterium partial pressure between 10^{-3} and 10^{-7} torr, while undesirable residual gases are gettered to the 10^{-9} torr range in a non-baked microscope system. The effectiveness of the zirconium foil getter has been monitored by following the partial pressures of the various gases with a CEC Type 21-611 mass spectrometer residual gas analyzer. Examples of field ion micrographs of niobium, nickel, iron, steel and cobalt are given. (auth)

34447 CHEMISORPTION OF OXYGEN ON POLYCRYSTALLINE TUNGSTEN. Singleton, J. H. (Westinghouse Electric Corp., Pittsburgh). pp 441-2 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.

See CONF-650643-(Vol.2).

The adsorption of oxygen was measured on a clean tungsten ribbon at 300 to 700°K. The studies have been made with particular attention to impurities such as carbon monoxide. The production of a clean tungsten surface requires modification of the usual flash filament technique, due to the interaction of atomic oxygen with the system walls. At 300°K oxygen adsorbs with a sticking probability of 0.10 and gives a total coverage of 1×10^{15} atoms/cm^2. After completion of adsorption at 300°K further oxygen adsorption, equivalent to 5×10^{14} atoms/cm^2, is observed if the ribbon is heated to 700°K. The oxygen adsorbed by clean tungsten at 700°K is equal to the total coverage obtained in the two step process and adsorption occurs in two distinct regions with sticking probabilities of 0.10 and 0.07. (auth)

34448 SORPTION OF HYDROGEN ON CONDENSED TITANIUM LAYERS AT LOW PRESSURES. Iwanovski, G. F.; Schirjaev, A. T. pp 451-5 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967. (In German).

See CONF-650643-(Vol.2).

Equilibrium pressures of hydrogen over evaporated Ti films were investigated with a mass spectrometer in the pressure range of 10^{-12} to 10^{-7} torr, and at temperatures of 77.2°K, 113.4°K and 178°K. (auth)

34449 INVESTIGATIONS ON SEMICONDUCTOR SURFACES BY DESORPTION SPECTROSCOPY. Kleint, Ch.; Moldenhauer, W. (Karl-Marx-Univ., Leipzig). pp 475-9 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967. (In German).

See CONF-650643-(Vol.2).

The method of desorption spectrometry introduced by H. D. Hagstrum for studying metal surfaces was used, in the form developed by P. A. Redhead, for the study of semiconductor surfaces. The heating of the samples was carried out with linear or reciprocal temperature plot, whereby the temperature of the samples was de-

termined by a thermoelement and controlled electronically. The measurements were made under ultrahigh vacuum conditions. After discussing the difficulties that arise as opposed to desorption studies on metals, the implementation and evaluation of the experiments are described, and desorption energies found on germanium are given for carbon monoxide deposition and for residual gas deposition. (auth)

34450 GAS DESORPTION BY SYNCHROTRON RADIATION IN STORAGE RINGS. Bernardini, M. (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). pp 481-5 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643-(Vol.2).

In order to perform experiments with colliding beams in storage rings it is essential that half-life of the stored beams be as long as possible, of the order of a few hours. It is thus necessary to obtain a work pressure of less than 10^{-9} torr in the vacuum chamber. Modern vacuum techniques easily allow the attainment of such low pressures, but the problem is made more severe by the presence of synchrotron radiation associated with the circulating beams. The radiation desorbs molecules on the doughnut walls both directly and by producing photoelectrons which in turn bombard the walls with consequent increase of the pressure. This second effect is larger than the first one by many orders of magnitude. This problem was studied in an indirect way in a 1.5 GeV electron-positron storage ring by means of a computation of the radiation spectrum, an evaluation of the quantum efficiency of the radiation and measurements of the desorption efficiency, i.e., the gas desorption due to bombardment of the ring walls by electrons. A series of new measurements of the electron desorption efficiency on different types of materials is reported. Gold, titanium and some types of stainless steel have been tested and it was concluded that stainless steel with low C content as AISI-304-L is satisfactory for storage ring use. A study of material treatments to further reduce desorption efficiency is also described. An argon ion (moderate power) bombardment by means of a cold discharge is extremely efficient in this sense. (auth)

34451 MEASUREMENT OF SMALL ION CURRENTS IN A MASS SPECTROMETER WITH A SCINTILLATION DETECTOR. Werner, H. W.; de Grefte, H. A. M. (Philips Research Labs., Eindhoven, Netherlands). pp 493-6 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643-(Vol.2).

Some factors are discussed which influence the lowest detectable ion current when using an ion-to-electron-to-photon converter plus a photomultiplier. The method has been described in the literature. In the method discussed the ions are accelerated to a potential of 25 kV, impinging on a metal surface producing electrons which in turn are accelerated onto a scintillator. The scintillator adheres to a glass window separating the vacuum system from the photomultiplier, which is in good optical contact with the window. The following factors are considered: accelerating voltages, field emission, absorption of cosmic and radioactive radiation in the scintillator, dark current from the photo cathode and spurious counts from the electronic equipment. Reduction of all disturbing effects has led to a minimum background count rate of 0.02 per sec, corresponding to a current of 3×10^{-21}A. (auth)

34452 UTILIZATION OF OMEGATRON TYPE MASS SPECTROMETER FOR THE ANALYSIS OF RELEASE GASES AND HYDROLYSIS GASES FROM ALKALI FLUORIDES SAMPLES AT HIGH TEMPERATURE. Trevisan, G.; Pizzini, S. (EURATOM-CCR, Ispra, Italy). pp 499-503 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643-(Vol.2).

The high vacuum drying procedure is widely employed in laboratory practice, but usually only the value of the final total pressure is given, which is actually attributed to the water pressure. Kinetic data for the water outgassing process are practically absent from literature. In the case of alkali halogenides pyrohydrolysis is a well known phenomenon, however no quantitative data are mentioned. In order to standardize a technique for drying fluoride mixtures, a mass spectrometric investigation was carried out. Weighed samples of known surface area of alkali fluorides were heated in boron nitride or graphite crucibles under UHV in a silica tube. The total pressure was measured with a Bayard-Alpert gauge and the partial pressures with an omegatron type mass spectrometer. Preliminary results indicate the occurrence of pyrohydrolysis at unexpected low partial water pressures. These results agree with previously given electrochemical evidence for hydrolytic processes in molten fluorides even under practically dry (<10 ppM) argon atmosphere. (auth)

34453 TWO-CHAMBER IONIZATION GAGE. Blauth, E. W.; Venus, G. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). pp 523-6 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643-(Vol.2).

To avoid interferences of pressure measurement with an ionization gauge, arising out of the interaction between the hot filament and the gas in the measuring volume, a two-chamber ionization gauge has been constructed. Electron beam production and the ionization chamber with ion collector are accommodated in two chambers which, to all purposes of vacuum technology, are largely separated. The two-chamber gauge head has been calibrated for the range of 10^{-1} to 10^{-10} torr, and its behavior tested by investigations of Blears effect. (auth)

34454 CRYO PUMP FOR TEMPERATURES TO 1,5°K WITH VERY LOW REFRIGERANT CONSUMPTION. Keck, K.; Schubert, G. U.; Wiechert, H. (Univ., Mainz). pp 559-64 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967. (In German).
See CONF-650643-(Vol.2).

A cryo pump, operating on the cryostat principle, has been developed, which is suitable for industrial and research uses. In this pump, helium is used as the refrigerant. In the development of this pump, special attention was given to the achievement of an extremely low consumption of refrigerant in order to minimize operating costs, and to produce a cryo pump which runs for as long a period as possible without having to refill with helium. This objective was accomplished by enclosing a cylindrical copper vessel in an optically opaque chevron radiation shield cooled with liquid air. The waste gas line of the helium vessel is connected via a highly effective heat baffle to a liquid air stock vessel. The system permits the temperature of the cryogenic surface to be lowered, in a simple manner, down to about 1.5°K without any extra consumption of refrigerant, thus allowing the effective removal especially of difficult condensable gases such as hydrogen. Details of the operating time, helium consumption and pumping speed of the cryo pump are given, and the results obtained by experiment are compared with theoretical considerations. (auth)

34455 SIMPLE CRYO-GETTER PUMP FOR ULTRAHIGH VACUUM. Riviere, J. C. (Atomic Energy Research Establishment, Harwell, Eng.); Thompson, J. B.; Read, J. E.; Wilson, I. pp 571-6 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643-(Vol.2).

A cryo-getter pump is described which consists simply of a liquid-nitrogen-filled reservoir on whose surface can be deposited a film of titanium from a filament. The composition of the residual gas, as well as the total pressure, has been observed during operation of the pump. The results show that hydrogen was the main constituent evolved from the titanium during evaporation, but that all the evolved hydrogen was taken up again by the cold film on cessation of evaporation. Previously pumped hydrogen was re-evolved as the film was warmed to room temperature, but then re-pumped by solution in the film on standing in contact with it. During heating of a specimen of mixed carbides, to provide a gas load, the total pressure near the specimen rose at one stage to over 10^{-6} torr; at the same stage, however, the pressure on the other side of the cryo-getter pump did not rise above 10^{-9} torr, indicating a sticking probability for the evolved gas, mostly hydrogen, of near unity. Despite the fact that parts of the system were not adequately outgassed, the ultimate pressure reached with the pump in operation was $1{:}6 \times 10^{-12}$ torr. (auth)

34456 PUMP SPEED MEASUREMENTS IN A NEW TYPE OF CRYOPUMPED VACUUM SYSTEM. David, R.; Venema, A. (Philips Research Labs., Eindhoven, Netherlands). pp 577-9 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643-(Vol.2).

A cryopump system has been constructed and connected directly to a Philips two-stage refrigerating machine, which produces low temperatures of about 14°K and 70°K. Experimental results for pumping speeds are reported. Gas analyses were made with a nude omegatron mass spectrometer. A comparison is made with the data published by other authors. (auth)

34457 GETTER-ION PUMPS WITH DIRECTLY HEATED TITANIUM EVAPORATORS. Nazarov, A. S.; Iwanovskii, G. F.; Kouznetsov, M. V. (Staatliches Komitee fuer Elektronik, Moscow).

pp 663-9 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

A series of getter-ion pumps of the evaporator type with resistance heated titanium-molybdenum evaporators is described. The series includes three types of pumps which have a pumping speed for air of about 5000 l/sec, 2000 l/sec and 500 l/sec respectively. Design and performance features of these pumps are reported. A short comparison of evaporator-ion pumps and sputter-ion pumps is given. (auth)

34458 SORPTION OF INERT GAS IONS BY TITANIUM. Radyabov, T. D.; Iwanovskii, G. F. (Staatliches Komitee fuer Elektronik, Moscow). pp 685-9 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

Apparatus and experimental techniques for studies of inert gas ion sorption by vapour-deposited titanium films, by compact-grained and coarse-grained titanium and by a titanium monocrystal were observed. The curves of thermal desorption and the quantity of the gas sorbed are given as a function of the nature of the target and the gas under study. Analysis of the experimental results is reported. (auth)

34459 ADSORPTION OF OXYGEN ON DISCONTINUOUS METAL FILMS. Fehlner, F. P. (Corning Glass Works, Corning, N. Y.). pp 691-703 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

Gas adsorption on extremely thin metal films has been studied by a resistance method under the following conditions: temperature, −196 to 100°C; pressure, 10^{-6} to 10^{-9} torr; gases, oxygen, nitrogen, and hydrogen, metals, titanium, nickel, gold, copper, aluminum; and film resistance, 2 to 400 kΩ. Film structure was studied by electron microscopy, electron diffraction, temperature coefficient of resistance, ac resistance, and dc current-voltage characteristics. The films were found to be composed of discontinuous metal islands. Electronic conduction between the islands was by a tunnelling mechanism which was affected by oxygen adsorption in all cases except gold. A pressure dependent induction period due to chemisorption was followed by a temperature dependent oxidation. Values for the inter-island distance (2 to 12 Å) and the room temperature oxidation rate constant for titanium and nickel ($K \approx 2 \times 10^{-9}$ cm for Ti and $\approx 1 \times 10^{-9}$ cm for Ni) were calculated and found to agree with published data. In the case of low melting point metals (Cu,Al), surface migration prevented any analysis of the change in resistance caused by oxygen adsorption. (auth)

34460 ADSORPTION MEASUREMENTS FOR XENON ON ACTIVATED CHARCOAL IN HIGH VACUUM AT −196°C WITH THE HELP OF A RADIOACTIVE TRACER. Dobrozemsky, R.; Hechtl, E.; Viehboeck, F. P. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria). pp 705-8 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967. (In German).
See CONF-650643–(Vol.2).

A xenon collector is described which is designed for a continuous load of approximately 1 mA xenon-ion current. This collector makes use of the adsorption of xenon on activated charcoal at low temperatures. The adsorption isotherm of Xe on activated charcoal at −196°C in the pressure range of 10^{-3} to 10^{-10} torr was determined to this end with the aid of the radioactive tracer Xe-133. The Xe partial pressure measurement was carried out with the "method of pumping off through a calibrated leak" in conjunction with a single-type Geiger counter set-up. (auth)

34461 ION BOMBARDMENT OF TUNGSTEN BY INERT-GAS IONS AND SUBSEQUENT ADSORPTION OF OXYGEN AS OBSERVED IN THE FIELD EMISSION MICROSCOPE. Vernickel, H. (Institut fuer Plasmaphysik GmbH, Garching, Ger.). pp 709-13 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.
See CONF-650643–(Vol.2).

The tungsten point of a field emission microscope (FEM) was bombarded by varying amounts of inert-gas ions (Ar,Xe) of 4 keV energy. During the early stages of the bombardment the work function is reduced by 0.1 eV. Continued bombardment produces a rough surface until finally the point consists of many small emitting centers and the FEM picture has almost entirely lost its structure and symmetry. For all values of the ion bombardment the change in work function and the sticking probability on a subsequent O_2-adsorption is, however, unchanged, although many defects have been produced on the surface. The FEM pictures taken during the O_2-adsorption indicate that many details of the surface structure are destroyed during the bombardment. Basically, however, the crystal structure is preserved. (auth)

34462 IMPROVEMENTS IN OR RELATING TO CRYOGENIC DEVICES. Chubb, John Norman (to United Kingdom Atomic Energy Authority). British Patent 1,075,316. July 12, 1967. Filed Feb. 24, 1965.

A cryogenic device is described which is comprised of three vessels containing a cryogenic liquid such as liquid He. The first vessel is provided with means to maintain the cryogenic liquid at a desired temperature. One of the vessels, a subsidiary vessel, communicates directly with the first vessel and to the other vessel, which is a storage vessel. A control allows the cryogenic liquid to pass from the subsidiary vessel to the first vessel when the liquid in both vessels are at the same temperature. The device may be used as a cryopump by contacting the gas within the system to be pumped with the outer surface of the first vessel. The surface must be in contact with the gas to be removed. The surface temperature of the vessel must be such that gas phase molecules of the gas to be removed will condense on the surface of the vessel. The rate of evaporation must be lower than the rate of condensation. (F.S.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 34428, 34451, 35038–35042, 35044, 35045, 35257, 35267, 35374, 35437, 35489, and 35697.

34463 (AD–649805) STUDY OF THERMAL NEUTRON CAPTURE GAMMA RAYS USING A LITHIUM-DRIFTED GERMANIUM SPECTROMETER. Orphan, Victor John; Rasmussen, Norman C. (Massachusetts Inst. of Tech., Cambridge). Jan. 1967. Contract AF 19(628)-5551. 206p. (MITNE–80; AFCRL–67-0104). CFSTI.

A gamma-ray spectrometer, using a 30 cc coaxial Ge (Li) detector, which can be operated as a pair spectrometer at high energies and in the Compton suppression mode at low energies provides an effective means of obtaining thermal neutron capture gamma spectra over nearly the entire capture gamma energy range. The energy resolution (fwhm) of the spectrometer is approximately 0.5% at 1 MeV and 0.1% at 7 MeV. Capture gamma-ray energies can be determined to an accuracy of about 1 keV. The relatively high efficiency of this spectrometer allows the use of an external neutron beam geometry, which simplifies sample changing. Using a 4096 channel pulse height analyzer, the capture gamma spectrum of an element may be obtained in about one day. Low cross section (order of 0.1 b) elements with many weak intensity gammas may be studied. Over 100 gamma rays have been identified in the spectrum of one such element, Zr. The spectra of Be, Sc, Fe, Ge, and Zr are presented. (auth) (TAB)

34464 (ANL–7320, pp 490–500) WALL-EFFECT CORRECTIONS IN PROPORTIONAL-COUNTER SPECTROMETERS. Snidow, N. L.; Warren, H. D. (Babcock and Wilcox Co., Lynchburg, Va.).

The measurement of neutron spectra with proton-recoil spectrometers sometimes requires wall-effect corrections. Presented is an accurate method of calculating the wall effect, when measuring an isotropic neutron flux, for a spherical counter without a dead region and for a finite-length cylindrical counter, either with or without a dead region at each end. Analytical expressions are obtained for four path-length probability functions, in which the geometric aspects are handled in an exact manner. The path-length probability functions and range data are applied to proton-recoil spectrometers to determine the energy lost in the sensitive region by protons starting in either the dead region or the sensitive region and stopping in the gas or hitting the wall. To verify the calculated wall effect experimentally, two cylindrical proportional counters, one containing ^3He in CH_4 and the other ^3He in H, were subjected to thermal neutrons. The observed spectra are compared with the calculated spectra. Results are given for cases in which most of the recoil particles lose some energy in collisions with the wall. (auth)

34465 (BMwF-FBK-67-33) DER AUFBAU EINES HOCHAUFLOESENDEN MAGNETISCHEN SPEKTROMETERS ZUR IMPULSBESTIMMUNG DER ULTRASTRAHLUNGSMUONEN IM BEREICH 10-5000 GeV/c. (A Magnetic Spectrograph Having a High Angular Resolution for a Study of the Momentum Spectrum of Cosmic Ray Muons Within the Range 10 GeV/c < p < 5000 GeV/c). Kraft, E. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). Apr. 1967. 32p. (In German). Dep.

A magnetic spectrograph is described that can be used to measure the muon spectrum up to the energy of 5×10^{12} eV. For deflection of the particles a solid iron magnet is used. The particle track is determined by six spark chambers. For good track accuracy, the spark chambers were triggered from avalanche. The total apparatus can be turned in vertical direction to any desirable angle. The purpose of the measurements is to determine the muon spectrum and their charge ratio. It is planned to study muon interactions with matter. (auth)

34466 (CONF-660527–, pp 177–85) PHOTOGRAPHIC SCANNING SYSTEMS IN THE APPLIED MATHEMATICS DIVISION, ANL. Hodges, D. (Argonne National Lab., Ill.).

Three hardware scanning systems, CHLOE, PAULETTE, and POLLY, are described. CHLOE, a general-purpose 35-mm-film digitizer has been in use for the last year; five different applications of the system are described. PAULETTE is a nuclear-emulsion-plate track scanner that will count the number of particle tracks occurring on the plates. POLLY is a high-precision film-scanning and -measuring device for 70-mm film. It is being designed to include an efficient man–machine interface to enable a human operator to serve, when necessary, as the pattern-recognition part of the machine. (auth)

34467 (CONF-660527–, pp 195–209) BUBBLE-CHAMBER DATA ANALYSIS: PAST, PRESENT, AND FUTURE. Snyder, James N. (Illinois Univ., Urbana. Dept. of Computer Science).

The approximately half-dozen bubble-chamber data-analysis systems either in use now or soon to come into use are reviewed from their inception to their current state of development. Their computer and programming needs, rather than hardware details and comparisons, are stressed. Conclusions are drawn about the increasing importance and the need for careful consideration of the computer portions of such systems both now and in the immediate future. (auth)

34468 (JINR–P13-3328) POROGOVYI CHERENKOVSKII SCHETCHIK S RADIATOROM IZ PLEKSIGLASA. (Threshold Cherenkov Counter With a Perspex Radiator). Petrukhin, V. I.; Pogosov, V. S.; Prokoshkin, Yu. D.; Simonov, Yu. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 17p. (In Russian). Dep.

The characteristics of a threshold Cherenkov counter with a perspex radiator were investigated with the beams of the JINR LNP synchrocyclotron by using a high speed five-beam oscilloscope. (auth)

34469 (JINR–P13-3342) SISTEMA STABILIZATSII VREMENNOGO SPEKTROMETRA NANOSEKUNDNOGO DIAPAZONA. (Stabilization System of Time-of-Flight Spectrometer of Nanosecond Range). Lapshin, V. G.; Omel'yanenko, M. N.; Rykalin, V. I.; Sinaev, A. N.; Khromov, V. P.; Tsisek, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 19p. (In Russian). Dep.

A stabilization system is described of a time-of-flight nanosecond range spectrometer using two reference time intervals between the womps from the semiconductor pulse lamps. The system allows stabilization of the threshold and the transmission factor. This system includes the whole spectrometer channel beginning from the photomultiplier up to the memory input. Thanks to the stabilization used, the permanent stability of the center of gravity positions of the measured time distributions is equal to $\pm 3.10^{-12}$ sec. (auth)

34470 (NP–16781, 49–54) OTHER PHYSICS. (University Coll., London (England). Dept. of Physics).

The various projects of the automatic methods, engineering design, and infrared groups are briefly outlined. (B.G.D.)

34471 (NP–16827) INVESTIGATION OF SPONTANEOUS FLUCTUATIONS IN THE APPLICATION OF SEMICONDUCTOR DIODES AS DETECTORS OF NUCLEAR RADIATION. Scott, Larry (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1966. 109p. Dep.

Thesis.

After a brief description of the electric and physical properties of diodes used as radiation detectors the following topics are discussed: radiation interactions with solids, noise in diodes, noise analysis of the application of diodes as radiation detectors, and an inexpensive radiation detector system based on the noise measurement technique. (B.G.D.)

34472 (ORNL–4091, pp 38–48) DETECTORS OF IONIZING PARTICLES AND RADIATION. (Oak Ridge National Lab., Tenn.).

Various topics dealing with the detection of ionizing particles and radiation are discussed. These include germanium purification, materials for semiconductor detectors, development of lithium-drifted germanium detectors, a simple cooler for lithium-drifted silicon detectors, spherical BF_3 proportional counters, investigation of factors affecting low-energy x-ray proportional counter resolution, and selection of signal resistors for type 303 G–M tubes used in a 1-r/hr probe Q-1916-22. (B.G.D.)

34473 (RHEL/R-143 and Suppl.) THE GENERAL STATISTICS PROGRAM "JESTER". Wagon, D. J.; Bryden, A. D. (Rutherford High Energy Lab., Chilton (England)). Apr. 1967. 101p. Dep. CFSTI. UK 10s.

Includes Chapter 5. Dictionary of Currently Available Stat Subroutines.

The statistics program Jester was developed as the final stage in the Rutherford High Energy Laboratory system for the analysis of data from bubble chamber events. A data summary tape containing the output from the geometry and kinematics programs is read by Jester, and quantities of physical interest are plotted in the form of histograms and two-dimensional plots. Instructions are written in an interpretive language, called stat language, in which each instruction corresponds to a call on a particular subroutine, which performs the calculations or outputs the results.

The present version is currently in use at the Atlas Laboratory of the Science Research Council, and has recently been converted to IBM 360/75. A slightly different version in Fortran II has also been developed at University College, London, and is in use on an IBM 7090. The supplement presents a description of all the stats currently available in Jester, together with the number and format of input and output arguments, and the errors which are called from each stat. (auth)

34474 (SFL-A-10) PORTABLE SURVEY METER FOR LOW-LEVEL RADIATION MEASUREMENTS. Isola, Aulis (Institute of Radiation Physics, Helsinki (Finland)). Apr. 1967. 8p. Dep.

A portable survey meter based on the ionization chamber principle was designed and constructed for low-level radiation exposure measurements. Some characteristics of the chamber are described. (auth)

34475 (UCRL-16845) ANALYTICAL CAPABILITIES OF A SEMICONDUCTOR X-RAY EMISSION SPECTROMETER. Hyde, Earl K.; Bowman, Harry R.; Sisson, David H. (California Univ., Berkeley. Lawrence Radiation Lab.). May 1966. Contract W-7405-eng-48. 34p. Dep. CFSTI.

A new x-ray emission spectrograph is described in which characteristic x-rays excited by radiations of ^{241}Am are detected by a lithium-drifted silicon semiconductor. Recent improvements in circuitry result in superior energy discrimination. The procedure for the calibration of the spectrograph is discussed and its usefulness as a quantitative analytical instrument is explored in two general cases: analysis of thick samples for an element in the 1-10% weight concentration range and analysis of thin samples of milligram size. (auth)

34476 (UCRL-17528) EXPERIMENTAL RESULTS OF SELECTION AND BIASING OF FET'S FOR LOW-ENERGY X-RAY AND γ-RAY SPECTROMETERS. Jared, Richard C.; Kilian, George W. (California Univ., Berkeley. Lawrence Radiation Lab.). May 1967. Contract W-7405-eng-48. 14p. Dep. CFSTI.

The experimental results are shown for the variation of resolution, gate voltage, and transconductance of a field-effect transistor by variation of the B plus voltage applied to the drain resistor. A short description of the selection technique of field-effect transistors for use in high-resolution systems, the preamplifier used, and several spectra showing the resolution obtained are presented. (auth)

34477 (USNRDL-TR-67-55) FABRICATION AND USE OF HIGH RESOLUTION LITHIUM-DRIFTED GERMANIUM GAMMA-RAY DETECTORS. Hurley, John P.; Mathiesen, James M.; DaGragnano, Victor L. (Naval Radiological Defense Lab., San Francisco, Calif.). May 22, 1967. 24p. CFSTI.

Experiments designed to study the behavior of various Ge(Li) detector systems are described. Techniques of improving energy resolution are discussed. Measurements of detector response to thermal radiation are described. A series of measurements showing the variation of line width as a function of energy is discussed. Finally, the appearance of anomalous peaks in the pulse height spectra is described. (auth)

34478 DETECTION OF WEAK BETA EMITTERS BY LIQUID SCINTILLATION COUNTING TECHNICS. I. INVESTIGATIONS ON THE OPTIMAL DETECTING CONDITIONS OF SOFT BETA EMITTERS. Nagy, L. G.; Torok, G.; Szarvas, T. (Polytechnic Univ., Budapest). Period. Polytech., Chem. Eng., 10: 279-302 (1966).

Some problems concerning determination of ^{3}H, ^{14}C, and ^{35}S by liquid scintillation counting were investigated. The high-voltage and temperature dependence of the photomultiplier was first evaluated, and it was established that the curves so obtained could be divided into 2 linear sections, the bend of the curve between them indicating the maximal high voltage to be used. The position of this knee was influenced by other counting parameters (amplifier gain and discriminator level) but the second section always had a linear shape, i.e., the average current simplification factor was directly proportional to the high voltage, and the direction tangent of the straight line was an unambiguous function of temperature. Thus the temperature dependence of the dark noise and the high-voltage dependence of the average current multiplicating factor, 2 significant data for the photomultiplier, could be measured without special auxiliary instruments. Besides the Richardson–Dushman formula concerning the thermionic emission, a cold emission current should be taken into consideration to describe the temperature dependence of the dark noise. Its numerical value was reported but the data were not sufficient to set up an equation of universal validity, because of the small temperature and high-voltage interval. On the basis of the results on the determination of the operating point, it could be fixed most rapidly by simultaneous consideration of the signal/noise = f(U) and η = f(U) curves. These curves also give overall and descriptive information on the photomultiplier's operating region, which thus gives a way to mark out irregular operating points for scales of special requirements. According to the results obtained with the extrapolation method for absolute activity determination, at optimal counting parameters the extrapolated values are 92% of the real activity. (BBB)

34479 AN IMPROVEMENT ON n-γ DISCRIMINATION. Seo, Takeshi; Sakisaka, Masakatsu; Yoshida, Koji (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 4: 293-6(June 1967).

An improved n-γ discriminator circuit was devised, which compares the peak amplitude of Owen pulses with that of the coincident linear pulses produced by an organic scintillation counter. The scintillation pulses induced by γ-rays were eliminated to an extent of more than 95% in ranges of electron energy up to 10 MeV and to about 80% between 10 and 12 MeV. (auth)

34480 REFRIGERATOR FOR BROOKHAVEN 80-INCH LIQUID HYDROGEN BUBBLE CHAMBER. Bamberger, J. A.; Brown, D. P.; Jensen, J. E. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. ASHRAE (Amer. Soc. Heat., Refrig., Air-Cond.) J., 7: No. 8, 33-9(1965). (BNL-9312).

A basic review is presented about the design and operation of a bubble chamber. The refrigeration is then discussed in much greater detail including design considerations, refrigeration cycle and requirements, nitrogen liquefier, nitrogen pre-cooler, hydrogen refrigerator-liquefier, and control systems. (B.G.D.)

34481 TRANSISTOR LOG-LINEAR COUNTING RATE SYSTEM FOR NEUTRON FLUX MEASUREMENTS. Marini, R.; Fiorido, M. (CAMEN, Pisa, Italy). Energ. Nucl. (Milan), 14: 423-9(July 1967).

An all-solid-state counting channel is described for low-level neutron-flux measurements in a nuclear reactor. The peculiar characteristics of the equipment are a new circuit to obtain a signal proportional to the pulse rate, a solid state log-converter with the compensation of the thermic effects, and the use of field-effect transistors as high-input-impedance transducers. Resolution time better than 1 μsec was obtained. (auth)

34482 WHOLE-BODY ANIMAL COUNTER USING A LIQUID SCINTILLATOR. Barnaby, C. F.; Orton, R. J. J. (London Univ.). J. Sci. Instrum., 44: 495-8(July 1967).

A liquid scintillation counter based on medicinal paraffin is described having properties which make it suitable for a wide range of animal experiments. The counter is relatively insensitive to both the distribution of activity within animals up to the size of large rabbits and to the size of sources for gamma-ray energies greater than about 0.8 MeV. The counter can be used for the direct comparison of the activity in the whole animal with that in part of the animal and therefore does not suffer from the errors introduced by a need for separate calibration. An activity of 1 nCi of an isotope of energy about 1 MeV can be counted to ±2% in a counting time of 28 min. The counter is compared with other systems. (auth) (UK)

34483 SPECS, A VERSATILE SPACE-QUALIFIED DETECTOR OF CHARGED PARTICLES. O'Brien, B. J.; Abney, F.; Burch, J.; Harrison, R.; LaQuey, R.; Winiecki, T. (Rice Univ., Houston, Tex.). Rev. Sci. Instrum., 38: 1058-67(Aug. 1967).

A versatile instrument code named SPECS (for Switched Proton Electron Channeltron Spectrometer) was developed for measurement of charged particles in space. Particles entering the device pass between a pair of deflection plates across which is established a voltage V_i. Particles of a given charge and different energies are then deflected into a set of five channeltron devices located on one side of the deflection plates, while particles of the opposite polarity but comparable energies are deflected into a funneltron located on the opposite side of the plates. Thus, electrons and protons are detected simultaneously in a total of six differential energy intervals. The voltage V_i is then changed over six steps: ±35 V, ±350 V, and ±3500 V. In this way electrons are measured over an energy range of about 50 electron volts (eV) to about 100,000 eV. Protons are measured over the same energy range, with the lowest detectable energy set by the intrinsic channeltron efficiency of detection of positive ions at some hundreds of electronvolts. The thirty-six energy channels can be measured in an adjustable cycle time as short as 1 sec. Stepping can be internally or externally synchronized. Different versions of the device have been built for numerous rocket and satellite applications, with weight between 900 and 1600 g, and power less than 1.5 W. Five small units have been flown to date on Javelin rockets, and the larger will be put into orbit in the satellites code-named Owls 1 and 2 and Aurora 1, while another set will be deployed by the astronauts on the lunar surface. The scientific advantages and flexibility of the units are described. (auth)

34484 SUPERCONDUCTING MAGNET BETA-RAY SPECTROMETER. Shera, E. B.; Bedesem, M. P.; Casper, K. J. (Western Reserve Univ., Cleveland). Rev. Sci. Instrum., 38: 1110-14(Aug. 1967).

A superconducting magnet spectrometer using lithium drifted silicon detectors has been constructed for the measurement of electron spectra. The spectrometer has a 4π geometry for electrons and a resolution limited only by the detectors. Spectral distortions arising from electron backscattering and gamma-ray interactions are eliminated by the achromatic focusing properties of a solenoidal magnet. (auth)

34485 ESTIMATION OF PHOTOFRACTIONS OF VERY LARGE NaI(Tl) SCINTILLATORS. Nakamura, Takashi; Hyodo, Tomonori (Kyoto Univ.). Nucl. Appl., 3: 446-50(July 1967).

The photofraction, i.e., the fraction of incident photons absorbed, and the Compton electron distribution of a very large NaI(Tl) scintillator are investigated. They are estimated from the measurement of energy spectrum of photons backscattered from the front face of a scintillator that is nearly semi-infinite for ^{60}Co and ^{137}Cs gamma rays. The estimated photofraction was 0.79 for ^{60}Co gamma rays and 0.85 for ^{137}Cs gamma rays. The Compton electron distribution obtained was compared with the results of Monte Carlo calculations. They show fairly good agreement. (auth)

34486 GAS SCINTILLATION COUNTER FOR THE DETECTION OF FAST NEUTRONS. Huebner, D.; Peter, G.; Seeliger, D. (Technical Univ., Dresden). Kernenergie, 10: 146-7(May 1967). (In German).

A gas scintillation counter on the basis of He + Xe and Ar is described. The linearity of energy dependence and the resolution of the detector were investigated during an experiment with fast neutrons. (auth)

34487 CONCEPT RESOLUTION IN SCINTILLATION SCANNING. Perinova, V.; Husak, V. (Palacky Univ., Olomouc Czechoslovakia). Phys. Med. Biol., 12: 333-44(July 1967).

Various definitions of resolution currently used in scintillation scanning are re-examined, and relationships derived for several of these. It is proved that these relationships hold for a single channel, as well as for the focal point of multichannel collimators. The theoretical results are compared with experimental data. It is shown that if the quantities which express the collimator resolution are not strictly defined, appreciable errors may arise. (auth)

34488 THERMAL-NEUTRON SPECTRUM MEASUREMENTS BY FOIL ACTIVATION. Ibarra, H. Jr.; Sher, R. (Stanford Univ., Calif.). Nucl. Sci. Eng., 29: 15-27(July 1967).

An experimental method for the measurement of thermal-neutron spectra by neutron-induced radioactivities in selected isotopes is described. Criteria from theoretical and experimental considerations are developed and applied for the selection of such detectors. The applications and limitations of the method are discussed. The experimental technique was applied to investigate neutron spectra in borated H_2O solutions, using four detectors: ^{164}Dy, ^{176}Lu, ^{151}Eu, and ^{197}Au. The spectra obtained are in good agreement with the known spectra. (auth)

34489 SCATTERING AND SELF-SHIELDING CORRECTIONS IN CADMIUM-FILTERED GOLD, INDIUM, AND 1/v FOIL-ACTIVATION MEASUREMENTS. Pearlstein, S.; Weinstock, E. V. (Brookhaven National Lab., Upton, N. Y.). Contract AT-(30-2)-Gen-16. Nucl. Sci. Eng., 29: 28-42(July 1967). (BNL-10799).

Calculations were performed of scattering and absorption self-shielding effects in the activation of bare and cadmium-covered Au, In, and 1/v detectors in infinite slab geometry in both monodirectional (beam) and isotropic flux, for a range of detector thicknesses. Energy loss on scattering is included. It is found that the calculated activation rates agree well with published data on detector activity vs cadmium thickness and with measurements of the sandwich type. The effect of scattering is to increase the activity of the detectors over what would be observed in the absence of scattering, in a beam flux, and to decrease it in an isotropic flux. These effects are due almost entirely to scattering from the cadmium covers rather than from the detector. The contribution to the activation from neutrons scattered once in the cover is found to decrease markedly with detector thickness for the resonance detectors, and to remain more or less constant for 1/v detectors, over a range of practical thicknesses. Effective cadmium cutoff energies have also been computed for the zero-thickness detectors and are in agreement with previously published tabulations. Tables of correction factors for scattering and for absorption self-shielding are presented. (auth)

34490 MOESSBAUER-SPECTROMETER MS 10. Jacob, Jens; Meisel, Werner; Neuhold, Dieter; Schnabl, Willy. Jena Rev., No. 5, 272-8(1966).

A brief review is presented on the Moessbauer effect and its applications in physics and chemistry. The design and performance of the MS10 Moessbauer spectrometer is then discussed. (B.G.D.)

34491 HIGH ENERGY MESON PRODUCTION IMPLICATIONS FROM OBSERVING THE COSMIC RAY LUNAR SHADOW. Wolfson II, Calman Jacob. Salt Lake City, Univ. of Utah, 1967. 104p.

Thesis.

A data-handling system designed for use with the Utah neutrino detector is described. This system is capable of handling a large number of cosmic-ray events, each having many parameters, and yielding the data in a digital form suitable for direct analysis on a computer. The entire system, although composed of inexpensive transistors and commercial-type integrated circuits, worked reliably in a prototype detector for six months. Using this prototype detector, an observation of the cosmic-ray lunar shadow was attempted. By using the magnetic field of the earth as a huge spectrometer and observing the bendings of the primary "shadow protons" and secondary "shadow muons," information concerning high (>100 BeV) energy nucleon-nucleon collisions was sought. The results indicated an effective lunar cross section for primary nucleons whose magnitude was about 5 times greater than that expected from simple geometrical considerations. No explanation was obtained. Finally, treating the effect as a lunar shadow, the ratio of primary proton energy to resulting pion energy was found to be about 25. This result is consistent with the Pal and Peters's production model. (Disser. Abstr.)

34492 NEUTRON SPECTROMETER FOR INVESTIGATION PHOTONUCLEAR REACTIONS. Jones, Dallas Wayne. Charlottesville, Va., Univ. of Virgina, 1966. 256p.

Thesis.

The application of pulse shape discrimination to the study of photonuclear reactions induced by a bremsstrahlung beam from a 65 MeV synchrotron was investigated. For the purposes of this investigation, a neutron spectrometer was constructed which employed a stilbene crystal (1 in. diam × 1 in.) and used pulse shape discrimination to reject gammas from the neutron pulse height spectrum. A new neutron-gamma discriminating system was developed which discriminates between neutrons and gammas by calculating the integral of the scintillation pulse in an integrating amplifier, stretching the scintillation pulse in a stretching amplifier to obtain a pulse proportional to the initial current surge from the photomultiplier, and comparing the two in a difference amplifier. The effects of pile up at high counting rates were studied by calculating the number of photoelectrons contributed by a 10 MeV neutron during a time interval ΔT to a gamma pulse following the first neutron at a distance of T μs. These calculations were made from experimental measurements, by Bollinger and Thomas, of the shape of the scintillation pulse from stilbene. A step by step procedure for analyzing the pulse height spectrum from stilbene crystals was also outlined and the neutron spectrometer was calibrated in terms of the electron and proton energies for equal pulse height response. The operation of the spectrometer was checked by analyzing the pulse height spectrum from a $^{11}B(d,n)^{12}C$ reaction to obtain the energies of the neutron groups and their intensities. Secondary bremsstrahlung produced in a thick target is emitted in a broadened $\cos^2\theta$ distribution relative to the primary bremsstrahlung beam and results in a high gamma to neutron ratio at the forward angles. This high gamma to neutron ratio causes pile up of neutron and gamma pulses during the synchrotron beam burst and results in accidental identification of gammas as neutrons. The effect of this pile up on the pulse shape discrimination was investigated by comparing the experimental angular distribution obtained from molybdenum and lead targets with the theoretical form $A + B \sin^2\theta$. An attempt was made to reduce the effects of pile up by varying the length of the bremsstrahlung beam burst, the maximum energy of the beam, the intensity of the beam, and the thickness of the absorbers placed in front of the detector. A report was made on these studies and the feasibility of this application of pulse shape discrimination. (Dissertation Abstr.)

Radiation Dosimeters

34493 (SFL-A-7) ROUTINE PERSONNEL DOSIMETRY WITH FLUORO-GLASSES. Toivonen, M. (Institute of Radiation Physics, Helsinki (Finland)). Mar. 1967. 15p. Dep.

A series of badge cases were constructed with silver activated phosphate glasses for personnel monitoring. The plastic construction is designed to accept many combinations of spherical

metal filters, and these badges may be used as specialized dosimeters by persons who are exposed to restricted range of radiation types. The Yokota glasses (squares, 8 × 8 mm^2) in different filter capsules were exposed, and the response characteristics were investigated. The slow neutrons and gamma rays were separated by the cadmium filter technique. The suitability of different badges for various practical applications was studied. A simple dose assessment system was implemented to identify the photon spectrum in cases where this is possible. Suitable formulas are given to compensate the energy dependent response, and an estimate of the accuracy of this assessment system has been determined. (auth)

34494 PERSONAL DOSIMETRY IN THE USE OF RADIATION FOR NONDESTRUCTIVE MATERIALS TESTING. Khol, G. Jad. Energ., 12: 146-9(Apr. 1966). (In Czech).

The requirements of the Czechoslovak regulations concerning the performance of personal dosimeters worn by workers engaged in the nondestructive testing of materials by radioactive methods are met by two types of dosimeters, which are, however, unsuitable for work on betatrons. For persons working with x rays, film badge dosimeters and blind chambers are approved, whereas film badge dosimeters and pocket ionization chambers are mandatory for work with radioisotopes. An accuracy of ±10 to 25% is regarded as sufficient. The dosimeters in use in Czechoslovakia are described and the experience acquired with them is reported. The theoretical and actual indicated doses for various types of dosimeter and radiation are clearly shown in comparative tables. The measurements obtained on a 15 MeV betatron using various dosimeters are also tabulated. (auth)

34495 AN ENAMEL COATED CaF_2:Mn THERMOLUMINESCENT DOSEMETER AND THE READING INSTRUMENT. Mihailovic, M.; Kosi, V.; Mihailovic, M. V.; Milavc, Z. (Univ. of Ljubljana, Yugoslavia). Phys. Med. Biol., 12: 395-402(July 1967).

A simple thermoluminescent dosimeter, with CaF_2: Mn powder baked in enamel, is described. The good mechanical and heat resistant properties of enamels are exploited. This very robust and small dosimeter shows a linear response from a few millirads to several thousand rads. The storage of dose is satisfactory and suitable for personnel dosimetry. The lower detection limit of the dosimeter is set by the non-irradiation induced thermoluminescence in the enamel. Smallest doses which can be detected are 5 millirads of x-rays, or 30 millirads of ^{60}Co γ-rays. A relatively simple non-digital reading instrument is described, which is able to measure doses over a range of four decades with a constant relative accuracy. (auth)

34496 THE USE OF LITHIUM FLUORIDE THERMOLUMINESCENT DOSEMETERS TO MEASURE THE DOSE DISTRIBUTION OF A 15-MeV ELECTRON BEAM. Almond, Peter R.; Wright, Ann; Lontz II, J. F. (Univ. of Texas, Houston). Phys. Med. Biol., 12: 389-94(July 1967).

A comparison was made of the central axis depth-dose curves obtained for 15-MeV electrons using an ion chamber and LiF dosemeters. The two uncorrected curves were very similar and gave the same depth-dose curves within experimental limits. Corrections that must be made to the LiF curve for energy and dose dependence, and to the ion chamber readings for the polarization effect, are small (a few per cent); the corrected curves are essentially in agreement within experimental errors. (auth)

34497 NEW TECHNIQUE FOR MEASUREMENT OF RADIATION. Med. Times, 94: 210a(Aug. 1966).

Applications of radioinduced luminescence for measuring radiation dosage are discussed. This method depends upon the fact that certain materials which have been exposed to ionizing radiation, such as x rays, will subsequently give off visible light when they are heated or placed under uv light. The amount of light given off is directly related to the amount of ionizing radiation exposure. Such luminescent dosimeters cover a much wider range of exposure than electronic devices. In addition, they are far more compact. A small capsule of material can take the place of a relatively large, easily damaged piece of equipment. Dosimeters using luminescent materials have been devised for persons occupationally exposed to radiation. Capsules are also being implanted in patients to measure doses given in the course of radiation therapy, or in animals for experiments. Identical capsules can be exposed at different locations and then processed at one facility. This provides standard readings so that the exact output of one x-ray machine or similar device may be precisely compared with that anywhere else in the world. This is particularly important for investigators who wish to compare their results with those of other laboratories. (BBB)

34498 PLANKTON SAMPLER (Engineering Materials). (E. I. du Pont de Nemours and Co., Savannah River Lab., Aiken, S. C.). (CAPE-1617).

5 drawings.

A 41 in. long sampler is described which is used in sampling plankton. The sampler consists of a latchable lid connected to the small end of a nylon cone. The large end of the cone, which is 12 in. in dia is connected to a nylon cylinder or basket which is 18.12 in. long. The cylinder, which has a welded metal frame, is connected to the cone by a canvas coupling. Lids are operated remotely. (For details see TID-4100 Suppl. 41) (F.S.)

34499 PHOTOGRAPHIC FILM DOSIMETRY. Principles and Methods of Quantitative Measurement of Radiation by Photographic Means. Becker, Klaus. New York, Focal Press, 1967. 223p. $21.50.

Translated by K. S. Ankeramit from Filmdosimetrie.

A comprehensive review is presented on the principles and techniques of personnel photographic film dosimetry. Topics include comparisons with non-photographic methods; historical survey; physical and chemical principles; dosimetry of high-energy quantum radiation, neutrons, beta particles, and mixed radiation fields; and practical film dosimetry such as badge design, laboratory techniques, and interpretation. (B.G.D.)

Radiometric Instruments

Refer also to abstracts 34334 and 34425.

34500 EQUIPMENT FOR INSTANTANEOUS FLOW MEASUREMENT. Wolf, R. (Electricite de France, Chaton). Houille Blanche, 21: 699-712(1966). (In French).

Methods and instruments were developed for flow measurements. The equipment featured a radionuclide (^{137}Ba) generator directly connected to a pneumatic injector, and two detectors on the outside of the pipe connected to an electronic counter giving a direct reading of the values from which the rate of flow was derived. In developing these measurement methods, use was made mainly of such medium-period radionuclides as ^{131}I, ^{82}Br, and ^{24}Na, with the following main purposes in view: to find applications for short pipes (i.e., up to 80 dia), experimental confirmation of mathematical approaches, and design and development of equipment for everyday use. The ^{137}Ba generator which was developed represented a new approach to the measurement of pipe flow by injection of radioactive salts. It relied on the natural ^{137}Cs -- ^{137}Ba relation with the parent ^{137}Cs being fixed to a highly selective ion-exchange resin. Washing this resin in water carried away the ^{137}Ba bred from the ^{137}Cs without moving the latter. As ^{137}Ba has a half-life of about 2.5 min, much higher radioactivity can now be fed into the pipe, for 100 min later it is reduced to only 2^{-40} times its original value. This even makes repetitive closed-circuit tests feasible. To determine the rate of flow in a pipe at least 50 dia long and whose cross-sections are known, a radioactive solution was injected and the time for passing 2 specific cross-sections A and B was detected from outside the pipe. Several mathematical approaches to the measurement problems are dealt with in an appendix. It is shown that, knowing the abscissa of the temporal center of gravity of the curve corresponding to the passage of the radioactive solution, the rate of flow in the pipe can be ascertained by external observation. Deformation due to the detector filters is discussed, and estimations made of the discharge error where interpretation is based on one particular geometrical point only. The advantages, applications, and potential scope of development of the method are also discussed. (BBB)

34501 NUCLEAR WEIGHING. Rowe, Snowden (Ohmart Corp., Cincinnati). Instrum. Contr. Syst., 40: 85-6(Feb. 1967).

Development, construction, and application of weighing devices employing radioisotopes are reviewed. Such scales have no moving parts, can be installed with minimum effort on existing conveyors, can provide direct readout, can act as a control instrument for weigh feeders and other devices, can be used on vibrating, apron, drag chain, belt, or air slide conveyors, and can be constructed in widths as wide as 6 ft. A basic scale consists of a steel C-frame, with the bottom tube reaching under the conveyor containing a strip radioisotope source, usually ^{137}Cs. A lead-shielded holder is equipped with an on-off shutter and built-in calibration absorber. The top tube, reaching across the conveyor, holds a strip of radiation-detecting cells, parallel to the radiation source. The cells convert radiation directly into an electrical current, without any power supply. The signal is amplified, multiplied by a belt speed signal (in a solid-state analog multiplier) and fed to a totalizer, which may activate control functions. Changes in the conveyor's load density, bed thickness, and material width are sensed by the amount of radiation reaching the cells, giving weight per unit length or unit belt loading. Numerous applications of radioisotope weighing devices are described. (BBB)

Miscellaneous Instruments and Components

Refer also to abstracts 34407 and 34896.

34502 (AD-649854) SIMULATION REQUIREMENTS FOR ROCKET-BORNE ION SAMPLING PROBES. Final Report, May 1, 1965–April 30, 1966. DeLeeuw, J. H. (Toronto Univ., (Ontario). Inst. for Aerospace Studies). Sept. 12, 1966. Contract AF 19(628)-5134. 16p. (AFCRL-66-672). CFSTI.

The requirements for laboratory model simulation of a rocket-borne ion-sampling probe are reviewed. Some successful experiments were performed to attain the proper value of the ratio of Debye length to model size. However, in the plasma flows produced so far, the ratio of electron temperature to gas temperature was found to be much higher than that relevant to the ionospheric conditions. (auth) (STAR)

34503 (CEA-R-3216) ETUDE ET REALISATION D'UN ANALYSEUR DE SPECTRES POUR RADIO-FREQUENCES. (Development of a Spectral Analyzer for Radio-Frequencies). Bourbigot, Jean (Commissariat a l'Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr. 1967. 157p. (In French). (EUR-3446.f). Dep.

Thesis.

An apparatus is described which was designed to show on the screen of a cathode ray tube the amplitude and frequency distribution of the spectral components of a given signal. The frequency range is from 5 kHz to 25 MHz. Two fundamental elements are used in the development of this apparatus, a ferrite and a ring modulator. The basic properties of these elements are studied and discussed. A theoretical study for the determination of the fundamental parameters of the analyzer is presented in the appendix. (auth)

For abstracts of individual papers see: 34466, 34467, 34505–34510, and 35359.

34504 (CONF-660527) USE OF COMPUTERS IN ANALYSIS OF EXPERIMENTAL DATA AND THE CONTROL OF NUCLEAR FACILITIES. Proceedings of a Symposium at Argonne National Laboratory, Illinois, May 4–6, 1966. (Argonne National Lab., Ill.). May 1967. Contract W-31-109-eng-38. 306p. Dep. CFSTI.

Separate abstracts are prepared for 9 of the 18 papers presented. Two papers were previously included in NSA. For abstract numbers of these papers see CONF 660527 in the report number index. Seven other papers were not sufficiently within the subject scope of NSA and therefore were not abstracted. (B.G.D.)

34505 (CONF-660527–, pp 13-19) USE OF A COMPUTER FOR DATA ACQUISITION AND PRELIMINARY PROCESSING. Norbeck, Edwin (Iowa Univ., Iowa City. Dept. of Physics and Astronomy).

Techniques for meeting the data-handling problems of a university nuclear-physics laboratory are described for two somewhat typical experiments. It is found that, when the on-line computer system is kept simple enough, it is not unreasonable for the user to write his own programs and that the addition of magnetic tape allows even a small computer system to handle very complicated types of data. The sorting and preliminary processing of the data on magnetic tape are done on a large off-line computer. (auth)

34506 (CONF-660527–, pp 21-32) THE NRU COMPUTER-CONTROL EXPERIMENT. Pearson, A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.).

An NRU computer-control experiment was run. The experiment was primarily an exercise in applying general-purpose digital computers to the control and instrumentation of a nuclear reactor plant. Closed-loop power control, monitoring, processing of in-core flux detector measurements, display techniques, and system reliability were explored. (auth)

34507 (CONF-660527–, pp 49-66) AUTOMATED DATA ANALYSIS AND CONTROL FOR CRITICAL FACILITIES. Cohn, Charles E. (Argonne National Lab., Ill.).

A DDP-24 computer is used for on-line data analysis and for control of a number of critical facilities. The computer accepts data through two 24-stage binary scalers connected to parallel input channels. Neutron-flux data accumulated at uniform counting intervals are fitted to asymptotic periods or are treated with an inverse-kinetics algorithm to yield reactivity vs. time. Control-element position may also be recorded as a function of time. The system can be used for control-rod calibrations, space-dependent sample reactivity worths, or measurements of shutdown reactivity as a function of time after scram. The computer has also been used to take an assembly through critical and up to a demand power by means of a driver circuit connected to the motor of a control rod. (auth)

34508 (CONF-660527–, pp 67-72) COMPUTER-CONTROLLED DIFFRACTOMETER EQUIPMENT. Aschenbrenner, R. (Argonne National Lab., Ill.).

An application of a computer-controlled system to x-ray- and neutron-diffraction studies is described, as well as a few of the factors determining the basis for the system design. (auth)

34509 (CONF-660527–, pp 77-83) AUTOMATED EXPERIMENTAL FACILITIES AND PROGRESS TOWARD AUTOMATED CONTROL OF THE ZGS. Martin, Ronald L. (Argonne National Lab., Ill.).

A high-energy-physics experiment now in progress at the Argonne Zero Gradient Synchrotron (ZGS) is described. Spark-chamber data are written on magnetic tape on-line. Data reduction is accomplished within 24 hr; this allows the experimental conditions to be modified accordingly during the run. A small computer system for use on-line with wire chamber and counter experiments is under construction at Argonne. A general description of the computer control system of the ZGS is given. Much of the equipment necessary is complete, and control experiments on various subsystems of the ZGS are beginning. The status of the computer control system is described. (auth)

34510 (CONF-660527–, pp 187-92) COMPUTER ANALYSIS OF BONE AUTORADIOGRAPHS AND MICRORADIOGRAPHS. Marshall, John H. (Argonne National Lab., Ill.).

The CHLOE film-scanning system is being used to digitize position and intensity information from autoradiographs and microradiographs of radioactive bone sections. A density calibration program that makes CHLOE a self-calibrating densitometer has been written. (auth)

34511 (EUR-3291.e) THEORY OF A NEUTRON POLARIMETER. Misenta, R. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr. 1967. 40p. Dep.

An experimental arrangement is proposed for the separation of those neutrons which have been scattered from an initially polarized beam of thermal neutrons without change of their initial spin direction, from those which have reversed their spin direction. This proposed neutron polarimeter consists of a polarizing crystal and of an analysing system. The polarizing crystal monochromatizes and polarizes the incident neutron beam from the reactor. The analyzing system analyzes the polarization and the energy of the scattered beam. It has two different states for the polarization analysis. In the "parallel state" only those neutrons pass the analyzing system and reach the detector which have maintained their initial spin and in the "antiparallel state" only those neutrons reach the detector which have reversed their initial spin direction. In addition to the polarization analysis the energy of those neutrons which pass the analysing system is measured by this system. The theory of a neutron polarimeter is developed. The influence of deviations of the polarization and analyzing efficiencies from 1 on the measuring accuracy of the polarization degree of the scattered beam is discussed and correction factors are derived. The separate measurement of the intensities of neutrons which have been scattered with and without spin flip allows the separation of coherently and incoherently scattered neutrons in neutron diffraction experiments, and in the determination of phonon dispersion relations and frequency distribution functions. Besides these new kinds of experiments all kinds of experiments are possible, e.g., measurement of the neutron spin flip probability of elements, depolarization studies in magnetic materials which have been performed up to now by the "double transmission method." (auth)

34512 (LA-3718) GAS-COLLECTION TECHNIQUE FOR MEASUREMENT OF FISSION-GAS RETENTION IN IRRADIATED Mo-UO_2 CERMETS. Patrick, A. J. (Los Alamos Scientific Lab., N. Mex.). May 17, 1967. Contract W-7405-eng-36. 6p. Dep. CFSTI.

A method is described for determining the quantity of rare gas fission products retained in irradiated molybdenum–uranium dioxide cermet fuel specimens. Information concerning the location of the gas in the cermet structure was also obtained. The method utilizes differential dissolution of molybdenum from the cermet followed by the separate dissolution of the uranium dioxide. Cold-trap pumping of the gases liberated during boiling of the solutions enables a high percentage of the rare gases originally in the cermet to be collected in a sample can. Contents of the sample can are determined by mass spectrometric and gamma counting techniques. (auth)

34513 (N-67-15457) EVALUATION OF THE CONSTANT MOMENTUM MASS SPECTROMETER FOR IONOSPHERIC IN-

VESTIGATIONS. Luther, H. M. (Pennsylvania State Univ., University Park. Dept. of Electrical Engineering). Nov. 1, 1966. 37p. (NASA-CR-81186; SR-283). CFSTI.

A mass spectrometer is being developed in which pulsed fields give all ions the same momentum. The final ion energy is therefore mass dependent. A mass spectrum can be obtained by analyzing the energy distribution of the ions reaching the collector. The advantages of this type of spectrometer are compactness, simplicity, light weight, absence of magnets, and ability to operate at comparatively high pressures. These characteristics make the apparatus suitable for analyzing the ion composition of the lower regions of the ionosphere. Preliminary results of attempts to find operating conditions insensitive to initial ion energies are discussed. (auth) (STAR)

34514 (ORNL-4091) INSTRUMENTATION AND CONTROLS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 1, 1966. (Oak Ridge National Lab., Tenn.). June 1967. Contract W-7405-eng-26. 242p. Dep. CFSTI.

Separate abstracts were prepared for 14 of the 15 sections. The extra section was on biomedical research and not sufficiently within the scope of NSA. (B.G.D.)

34515 (ORNL-4091, pp 1-14) NANOSECOND CIRCUITRY AND TECHNIQUES. (Oak Ridge National Lab., Tenn.).

The design, operation, and performance of various instrumentation are discussed. Topics included were tunnel diode discriminators, a picosecond peak current meter, connection of fast- and slow-amplifier systems to semiconductor detectors, a fast fission chamber amplifier-discriminator system, equipment for measuring the ratio of neutron capture-to-fission cross sections at keV neutron energies, a neutron time-of-flight spectrometer, and a combined energy and mass spectrometer control system. (B.G.D.)

For abstracts of individual sections see: 34472, 34515-34526, and 35361.

34516 (ORNL-4091, pp 15-21) PULSE COUNTING AND ANALYSIS. (Oak Ridge National Lab., Tenn.).

The design, operation, and performance of various types of instrumentation for pulse counting and analysis are discussed. Topics include pulse shaping, network signal-to-noise ratios, a precision mercury pulse generator, the Argonne analog pulse-height computer, modular power supplies, a NIM system type III power supply, time-to-amplitude converters, and a field-effect transistor preamplifier for BF_3 detector. (B.G.D.)

34517 (ORNL-4091, pp 22-35) MISCELLANEOUS ELECTRONICS DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Various instrumentation developed at ORNL are described. These include a direct-current integrator, a herbage probe, an echo selector system for ultrasonic analysis of metal samples, a statistical pulse display system, a transistorized pulse-gating and emission-regulating circuit for a 2-MeV electron accelerator, a dynamic range expander and phaseshift control, an alpha monitor for heavy-element chemistry, a recording fluorometer, a double beam photometer, a beta excited light source photometer, and a high-count rate neutron counting channel. Specifications for G-M tubes are also presented. (B.G.D.)

34518 (ORNL-4091, pp 82-90) DATA COLLECTION AND ANALYSIS. (Oak Ridge National Lab., Tenn.).

Various topics on data collection and analysis at ORNL are discussed. These are activities of the data processing and analysis group, data collection and analysis for the MSRE, MSRE computer programming, thermocouple table status report, and work order and labor summary computer program. (B.G.D.)

34519 (ORNL-4091, pp 49-67) RADIATION MONITORING. (Oak Ridge National Lab., Tenn.).

Various types of radiation monitoring systems are reported for use in accelerator, reactor, and other types of environments. The monitoring systems also include personnel radiation monitors. (B.G.D.)

34520 (ORNL-4091, pp 68-81) INSTRUMENTATION FOR AUTOMATIC CONTROL AND DATA ACQUISITION. (Oak Ridge National Lab., Tenn.).

The development of various types of instrumentation for automatic control and data acquisition are discussed. Topics include computer-controlled neutron diffractometers, a triple-axis neutron spectrometer control, a computer control of triple-axis neutron spectrometer, computer-controlled x-ray diffraction systems, a multianalyzer stored-program data acquisition system interface, modification of multichannel analyzers for data center use, a computer-controlled communication system for the Dextir data logging system, a data acquisition system for reactor division and thermonuclear division experiments, a single-axis x-ray diffractometer programmer, a data collection system for the liquid-sample x-ray diffractometer, a digital data acquisition system utilizing a teletype ASR 33 teletypewriter, and diffractometer equipment. (B.G.D.)

34521 (ORNL-4091, pp 91-101) PROCESS INSTRUMENTATION AND CONTROL SYSTEMS ENGINEERING. (Oak Ridge National Lab., Tenn.).

Various topics on process instrumentation and control systems engineering are discussed. These include the thorium utilization program, Nuclear Safety Pilot Plant, Transuranium Processing Plant, Project Salt Vault, fixation of radioactive waste in asphalt, Containment Research Installation, and planning in the process control and instrumentation section. (B.G.D.)

34522 (ORNL-4091, pp 102-35) PROCESS INSTRUMENTATION DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

The development of various types of process instrumentation is discussed. Topics include a power-proportioning device, a basic control unit, program generators, a constant-power supply, a furnace burnout monitor, a multipoint recorder programmable range converter, a tantalum process valve, the graphite evaluation program, the nuclear safety pilot plant fog detector, a pneumatic scanning system, microsphere production, the present status of resistance-type liquid-metal level detectors, instrument development aids, nozzle flow stability in pneumatic temperature measurements, a system for measuring the thermal diffusivity of solids by the laser flash technique, an automatic differential thermal analyzer, electrolytic polishing controller for electron microscope specimens, and a precision optical extensometer. (B.G.D.)

34523 (ORNL-4091, pp 136-82) REACTOR INSTRUMENTATION AND CONTROLS. (Oak Ridge National Lab., Tenn.).

The development of reactor instrumentation and controls is discussed. Topics include heavy-water-moderated organic-cooled reactors; multistage flash evaporator plant dynamics; power source contribution to evaporator plant dynamics; the inherent dynamic characteristics of the MSRE; the power burst facility analog computer studies; analog computer model of the boiler hot test rig; analog computer analysis of a bimetallic loop; operation procedures for the HFIR; effect of destructive excursion on HFIR containment; subcritical reactivity measurements using fluctuations from a pulse-type detector; cross-spectral density techniques; measurement of reactor shutdown margin in high gamma fluxes; analog simulation of neutron fluctuations in a zero-power reactor; measurement of delayed neutron fraction in the MSRE; HFIR core evaluation; neutron power density in power reactors; reactor acoustical noise; on-line reactivity computation for the HFIR; digital simulation of the HFIR control system; an algorithm for calculating reactivity from neutron flux; control and safety system for the TSF-SNAP reactor; instrumentation for the Aberdeen pulse reactor, HFIR, and MSRE; a neutron counting system with a fission detector and a flexible balanced line; and the nuclear safety information center. (B.G.D.)

34524 (ORNL-4091, pp 183-91) IN-PILE EXPERIMENTS. (Oak Ridge National Lab., Tenn.).

Various topics associated with in-pile experiments at ORNL are presented. These include instrument engineering support for in-pile experiments, instrumentation for molten-salt breeder reactor in-pile molten salt experiment, improved temperature control for the ORR C-1 experiment, BeO graphite comparability test, fuel graphite comparability test, fast gas-cooled reactor capsule tests, and the ORR HN-2 pneumatic tube control system. (B.G.D.)

34525 (ORNL-4091, pp 196-208) MAINTENANCE SERVICES. (Oak Ridge National Lab., Tenn.).

Various aspects associated with the instrument maintenance program at ORNL are discussed. These include the maintenance activities of the monitoring systems development group; activities of the special electronic services group; maintenance and services for the HFIR, ORR, LITR, BSR, and PCA; conversion of the Bulk Shielding Reactor to operate at 2MW; measurement of BSR differential pressure and temperature; installation and maintenance of experiments at the ORR and LITR; and second-generation instrumentation at the MSRE. (B.G.D.)

34526 (ORNL-4091, pp 192-5) INSTRUMENTATION FOR REACTOR DIVISION TEST LOOPS. (Oak Ridge National Lab., Tenn.).

Various topics associated with instrumentation for ORNL's Reactor division test loops are presented. These include instrument services for boiling-liquid metal loops, instrumentation for potassium systems, and conversion of temperature recorders to °C. (B.G.D.)

34527 (UCRL-13279) THE DEVELOPMENT OF A CAPACITANCE CONTROLLED RADIATION-HARDENED FM OSCIL-

LATOR. Final Report. Eden, Harry D.; Lee, Lorin (Nortronics, Newbury Park, Calif. Applied Research Dept.). [1966]. Contract W-7405-eng-18. 51p. (ARD-66-55R). Dep. CFSTI.

For Univ. of California, Livermore.

The development of a capacitance-controlled radiation-hardened FM oscillator which may be used in a sensor configuration for determining the physical reaction of certain materials to a severe prompt radiation environment is discussed. Included also as a part of this development is the investigation, test, and ultimate selection of potting materials which would serve as a dielectric and encapsulant for the circuits and components of the sensor. (auth)

34528 (UJV-1716) OBVOD PRO REGULACI A STABILIZACI PROUDU ZHAVICIHO VLAKNA ELEKTRONOVEHO ZDROJE. (Description of Control and Stabilization of Alternating Circuit of Electron Beam Source). Srepl, F. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1967. 9p. (In Czech). Dep.

A simple circuit for stabilizing and control of an alternating circuit for heating the filament of an electron gun is described. The circuit consists of a magnetic amplifier as a control element and a diode with saturating anode current as a detector. (auth)

34529 (AEC-tr-6715) AUTOMATIC ANALYZERS OF RADIOCHEMICAL MEDIA. Shelemin, B. V. Translation of Avtomaticheskie Analizatory Sostava Radiokhimicheskikh Sred, Atomizdat, Moscow, 1965. 269p. (IPST-Cat.-1803). CFSTI.

A translation of an original Russian language book on automatic analyzers of radiochemical media is presented. The original Russian book was previously abstracted for NSA as 19:42449. Some of the topics included are chemical processing of irradiated reactor fuels; control schedules of irradiated fuel processing plants; apparatus for determining hydrogen ion activity (pH meters); conductometers; dielectrometers; titrimeters; polarographs; coulometers; fluorescence photometers; photometers and spectrophotometers; x-ray, gamma, NMR, and EPR spectrometers; absorption and scattering monitors of radioactive radiations for solution analysis; alpha, beta, gamma; and neutron radiation monitors for radiochemical analysis of solutions; ultrasonic analyzers; instruments based on combined methods of analysis of multicomponent solutions; mass spectrometers; and chromatographs. (B.G.D.)

34530 THE MONOPOLE: A NEW INSTRUMENT FOR MEASURING PARTIAL PRESSURES. Hudson, J. B.; Watters, R. L. (General Electric Co., Schenectady, N. Y.). IEEE (Inst. Elec. Electron. Eng.), Trans. Instrum. Meas., IM-15, No. 3, 94-8(Sept. 1966).

Design parameters appropriate to the construction of a monopole type mass spectrometer suitable for use as an ultra-high vacuum partial pressure analyzer are developed and elaborated. Performance results of an instrument built to these parameters are presented. Results indicate a usable mass range of 300 amu, with unit resolution over the whole range. Ultimate sensitivity is in the 10^{-14} Torr partial pressure range. (auth)

34531 LOCK-ON MAGNETOMETER UTILIZING A SUPERCONDUCTING SENSOR. Forgacs, R. L.; Warnick, A. (Ford Motor Co., Dearborn, Mich.). IEEE (Inst. Elec. Electron. Eng.), Trans. Instrum. Meas., IM-15: No. 3, 113-20(Sept. 1966).

A magnetometer utilizing a superconducting quantum interference device (SQUID) as a magnetic flux sensor is described. Its unique capabilities include: sensitivity of about an order of magnitude better than that of heretofore published magnetometers of other types, measurement range extending to zero field, and appreciable frequency response at high sensitivity (12 c/s bandwidth at 10.7 μGs full scale). The SQUID is a null detector in a feedback circuit in which unknown field changes are measured in terms of bucking field changes. Some limitations and design considerations are discussed. A recording of micropulsations of the earth's magnetic field is shown. (auth)

34532 WIDE-RANGE MULTI-INPUT PULSE HEIGHT RECORDING SYSTEM. Humphreys, Russ (Louisiana State Univ., Baton Rouge). Rev. Sci. Instrum., 38: 1123-7(Aug. 1967).

A system is described which can photographically record with one dual-beam oscilloscope the amplitudes of 10 simultaneous photomultiplier pulses over a four-decade dynamic range with an accuracy of ±1.5% over the entire range. The signal processing time is 2.2 μsec. The basic circuit is a logarithmic pulse-height-to-time converter with two triggering levels, requiring twelve transistors per input channel. The dynamic range of the device could be easily extended to six decades, and the two-level technique can be applied to digitized recording systems and pulse height analyzers. The circuit has been found to meet the above specifications over a temperature range from −19 to +38°C. (auth)

34533 PHOTOEMISSIVE YIELD OF Cs_3Sb PHOTOCATHODE AND ITS DEPENDENCE ON TEMPERATURE. de'Munari, G. M. (Univ., Parma, Italy. Istituto Nazionale di Fisica Nucleare, Milan); Mambriani, G.; Giusiano, F. Rev. Sci. Instrum., 38: 1128-32(Aug. 1967).

A method which allows measurements of the photoemissive quantum yield of a Cs_3Sb cathode of a photomultiplier is described. The method consists of an accurate control of the photocathode polarization to separate its eventual effects from the dependence of the quantum yield on the temperature. Measurements thus performed on four 56AVP phototubes have been interpreted as an up-to-now unknown variation of the quantum yield due to the temperature. The measurements suggest that the Cs_3Sb could exist in two states, one of which, never noticed before, is stable only below (260 ± 2)°K (the transition temperature), and which moreover is very sensitive to the absorbed energy. This low temperature state has a low quantum yield (for whitish-blue light), which, depending on the absorbed energy, can be even five to seven times lower than the yield of the usual high temperature state of Cs_3Sb. (auth)

34534 HIGH-REPETITION-RATE BURST PULSER. Paxson, G. Donald (Univ. of California, Berkeley). Contract W-7405-eng-48. Rev. Sci. Instrum., 38: 1137-9(Aug. 1967). (UCRL-17309).

This paper describes a simple and reliable thyratron circuit capable of generating high energy pulses at repetition rates of 5000/sec or higher. Design considerations and factors limiting the maximum repetition rate are discussed. (auth)

34535 MODIFICATIONS OF AN A-60 SPECTROMETER FOR NUCLEAR RELAXATION STUDIES OF CHEMICALLY-SHIFTED PROTONS. Anderson, J. E.; Steele, J.; Warnick, A. (Ford Motor Co., Dearborn, Mich.). Rev. Sci. Instrum., 38: 1139-44 (Aug. 1967).

Circuit modifications are described which enable a Varian A-60 spectrometer to be used for relaxation studies of chemically shifted protons. T_1 and T_2 values greater than 0.1 sec can be measured on the modified instrument at ambient temperature. Owing to severe convection effects in the probe assembly, relaxation measurements are made with difficulty at other temperatures. Methods of time-averaging relaxation data are also discussed. (auth)

34536 PRESSURE GAUGE FOR PLASMAS SUBJECTED TO LARGE DYNAMIC ELECTRIC AND MAGNETIC FIELDS. Grabowsky, W. R.; Durran, D. A.; Gerard, M. E. (Aerospace Corp., El Segundo, Calif.). Rev. Sci. Instrum., 38: 1160-1(Aug. 1967).

A gage, comprised of a transducer and a resistance bridge, that solves the environmental problem of pressure measuring instrumentation of a pulsed MHD wind tunnel is described. (L.B.S.)

34537 HIGH TEMPERATURE INDIRECTLY HEATED CATHODE STRUCTURE. Jensen, J. T. Jr.; Klebanoff, J.; Haas, G. A. (Naval Research Lab., Washington, D. C.). Rev. Sci. Instrum., 38: 1178-9(Aug. 1967).

A heater cathode designed to provide a method of indirectly heating a gun cathode to temperatures where low vapor pressure cathode materials can operate is discussed. A self-supporting bare tungsten filament formed as a double helix served as the most mechanically stable heater design. Heater life measurements of the cathode structure are given, which show a direct correspondence between the filament current and the life expectancy. (L.B.S.)

34538 APPLICATION OF THE ELECTRON MICROSCOPE FOR PRODUCTION OF PSEUDO-KOSSEL PATTERNS AND THEIR USE IN THE DETERMINATION OF LATTICE CONSTANTS OF A BERYLLIUM-4.4 WT. PERCENT COPPER ALLOY. Witt, Fred; Damiano, Victor V.; London, Gilbert (Franklin Inst., Philadelphia). Rev. Sci. Instrum., 38: 1069-73(Aug. 1967).

A simple modification to an RCA EMU3G electron microscope is described which makes it possible to obtain transmission pseudo-Kossel patterns. These were analyzed to obtain accurate lattice constants for a hexagonal beryllium-4.4 wt % copper alloy. (auth)

34539 ULTRAHIGH VACUUM HIGH TEMPERATURE SUBSTRATE HEATER. Naber, C. T. (McDonnell Co., St. Louis). Rev. Sci. Instrum., 38: 1161-2(Aug. 1967).

A substrate heater for use in ultrahigh vacuum thin film deposition is described. The heater heats by electron bombardment of a tungsten sheet which is in contact with a number of substrates. The control system consists of a platinum−rhodium thermocouple and a silicon controlled rectifier temperature controller. (L.B.S.)

34540 PRESSURE PROBES FOR RESEARCH IN PLASMA DYNAMICS AND DETONATION. Jones, T. G. (Univ. of Colorado,

Boulder); Vlases, G. C. Rev. Sci. Instrum., 38: 1038-42(Aug. 1967).

Three pressure transducers that can be used in high temperature gas dynamic studies are described and their performance discussed. It is shown that the Baganoff gage can be usefully employed to study high temperature and pressure gaseous detonation wave phenomena, provided the gage is constructed from glass. This modification results in greatly reduced sensitivity, but preserves the high frequency response and overall characteristics of the original gage. A second gage, using the pressure bar principle, is shown to have wide application in studies of high temperature shock waves in the presence of large magnetic and electric fields, provided the pressure bar is constructed from a nonconductor having appropriate properties. The results of experiments with this gage indicate that, even with poor acoustic matching of the gage elements, it is possible to obtain an accurate estimate of the pressure behind a shock or blast wave with a time resolution of about 2 μsec. The third device described is designed for use where only the accurate arrival time of a pressure pulse is desired and has been used extensively at this Laboratory for plotting shock trajectories in magnetic shock tubes. (auth)

34541 TUNGSTEN–RHENIUM THERMOCOUPLES FOR USE AT HIGH TEMPERATURES. Asamoto, R. R.; Novak, P. E. (General Electric Co., Sunnyvale, Calif.). Rev. Sci. Instrum., 38: 1047-52(Aug. 1967).

Tungsten-rhenium thermocouple systems were evaluated for use in measuring temperatures between 1600 and 3000°C. Temperature-millivolt relationships were extended from 2300 to 3000°C for bare-wire W3Re/W25Re and W5Re/W26Re thermocouples in vacuum. The performance of W26Re sheathed, high-fired beryllia-insulated thermocouples was limited only by the melting point of the beryllia insulation (~2550°C). The thermoelectric output of high-fired thoria-insulated thermocouples sheathed in W26Re was determined and found to be reliable up to at least 2850°C, when corrected for electrical shunting through the insulation. Stability of high temperature thermocouples using thoria insulation was within ±0.3 mV (±40°C) when held at 2425°C for 148 h. (auth)

34542 TECHNIQUES FOR CONDUCTING SHOCK TUBE EXPERIMENTS WITH MIXTURES OF ULTRAFINE SOLID PARTICLES AND GASES. Watson, R.; Morsell, A. L.; Hooker, W. J. (Heliodyne Corp., Van Nuys, Calif.). Rev. Sci. Instrum., 38: 1052-7(Aug. 1967).

Techniques have been developed for conducting shock tube experiments on mixtures of fine solid particles and gases. Particles with diameters of 1 μ and smaller are prepared by grinding in a dry atmosphere. The powdered material is injected into the shock tube test section by opening a valve connecting the evacuated shock tube with a tank containing gas into which the powder has been previously suspended by a pressurized injection. The axial distribution of powder in the shock tube has been measured both by determining the weight of powder which has settled out on small stainless steel slides placed in the shock tube and by observing the optical absorption from a long-life reaction product of the shock-heated powder-gas mixture as the mixture sweeps by an observation port. Typical operating results are presented, including particle size distribution of a solid material after grinding, powder distribution along the shock tube axis after injection, and oscilloscope records of absorption at 2536 Å by the CF_2 formed from Teflon decomposition behind the incident shock wave. (auth)

34543 EFFECT OF LOCALIZED GAS DENSITIES ON VACUUM IONIZATION GAGES. Moore, B. C.; Bergquist, L. E.; Camarillo, R. G.; Larson, R. (Douglas Aircraft Co., Inc., Santa Monica, Calif.). pp 251-4 of 1965 Transactions of the Third International Vacuum Congress, June 28–July 2, 1965, Stuttgart, Germany. Vol. 2. Adam, H. (ed.). New York, Pergamon Press, 1967.

See CONF-650643-(Vol.2).

Under uniform flux conditions, changes in localized gas densities result from non-uniform vacuum chamber temperatures. These changes cause variations in nude ionization gauge readings. A system with a temperature-controlled stainless steel disk and a chamber shroud provided two groups of molecules. These entered a nude ionization gauge at independently controlled velocities. Gauge readings were taken when the shroud and disk temperatures were the same and repeated when the temperatures differed. The ratio of these readings is β. A theoretical model was used to calculate the kinetic thermal accommodation coefficient α from the measured β. Experiments were conducted with helium and nitrogen gases. When the shroud was at 285°K, the disk at 78°K and coated with water, β for nitrogen was 1.42, and α was greater than 0.99. Helium under these conditions had a β of 1.16 and an α of 0.62 ±[illegible]. β's and α's for other temperature conditions are presented. Results from nitrogen tests with the cryopanels operating indicate that the nude ionization gauge was directionally sensitive. (auth)

34544 NUCLEAR ELECTRONICS AT THE C.E.A.: ACHIEVEMENTS AND PROSPECTS. Doireau, M. Onde Elec., 47: 724-30(June 1967). (In French).

The experience acquired at the C.E.A. has made possible the industrial development of standard electronic equipment which meets the general requirements of nuclear research centers: Renatran basic plug-in function units, fast electronics, and electronic equipment for the control of nuclear reactors. Among other achievements, are mentioned the development of nuclear detectors, multi-dimensional analyzers, the use of on-line computers in connection with nuclear experiments or for centralized treatment of measurements. Besides the C.E.A. has taken part in the development of nonspecific nuclear measuring instruments such as CRT oscilloscopes and pulse generators. (auth)

34545 TRANSISTORIZATION OF STANDARD KIT ELECTRONIC SETS FOR RADIATION MEASUREMENTS. Kubalek, Jiri. Jad. Energ., 13: 224-6(June 1967). (In Czech).

A brief review is presented on the problems relating to the design, fabrication, and performance of transistorized equipment for radiation measurements. The various factors influencing the production and quality of the equipment are analyzed. (tr-auth)

34546 ELECTRONIC EQUIPMENT FOR THE CONTROL OF A REACTOR. Blaho, Dusan (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Jad. Energ., 13: 226-9(June 1967). (In Czech).

Electronic equipment used for the control of reactors is described. The equipment consists of linear pulse amplifiers, pulse height discriminators, and linear and logarithmic rate meters. (tr-auth)

34547 PREAMPLIFIER /Q-2825/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–1614).

1 drawing.

A preamplifier is described which is used with a fission detector and a flexible balanced line input. The preamplifier is contained in a gold plated copper shield. The first section of the preamplifier has a gain of ≈10, a second section gain of ≈100 and in the last section the gain is ≈1 with single output into an 82 ohm load. A pulse transformer is also described. (For details see TID-4100 Suppl. 41) (F.S.)

34548 DATA CENTER, INPUT SYSTEM FOR CDC-160 A COMPUTER (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE–1605).

3 drawings.

A data center, part of which is described, consists of an input system for a CDC-160A computer. The center permits transmission of information between a program-controlled computer and various pulse height analyzers or analog-to-digital converters connected to the computer through the data center. Direct transmission of data to the computer eliminates paper tape storage and handling. The maximum input rate at the center is 10,000 characters/sec. Actual input depends on the input device. The system uses input from a fission fragment time-of-flight analyzer (Q-2159) and/or Victoreen 800 channel pulse height analyzer (Q-2864). (For details see TID-4100 Suppl. 41) (F.S.)

34549 NEREM RECORD. NORTHEAST ELECTRONICS RESEARCH AND ENGINEERING MEETING, BOSTON, NOVEMBER 2–4, 1966. VOLUME VIII. FIRST EDITION. Newton, Mass., Ernest E. Witschi, Jr., 1966. 256p. (CONF-661127).

Separate abstracts are prepared for 22 of 122 papers presented. The remaining papers were not sufficiently within the subject scope of NSA and were not abstracted. (B.G.D.)

For abstracts of individual papers see: 34374–34376, 34554–34558, 34613, 34614, 34797–34799, 34997–34999, and 35104–35109.

Radiation Effects on Instruments and Instrument Components

34550 (CEA-R-3154) ETUDE DU COMPORTEMENT D'UN PHOTOMULTIPLICATEUR SOUS RAYONNEMENTS NUCLEAIRES. (Behaviour of an Irradiated Photomultiplier). Verdant, Robert (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Apr. 1967. 137p. (In French). Dep. Thesis.

With the aim of using scintillation detectors for the starting-up, the study of transient phenomena, the control or the safety of a nuclear reactor or of a critical assembly, the behavior of 8 photomultipliers (Radiotechnique 51 AVP and UVP, and EMI 9524 B) was studied in the gamma flux of 1 to 10^9 Rh^{-1} in a storage well, and in an EL 2 reactor channel where the exposures varied be-

tween 1 to 2×10^3 Rh^{-1} and 6×10^5 to 5×10^7 n. $cm^{-2} \cdot s^{-1}$. Spurious pulses are produced by this radiation at the photomultiplier anode. By comparing the amplitudes of these pulses to those produced by a NaI scintillator, it was observed that their maximum energy level was about 100 keV at 10^3 Rh^{-1} in the gamma flow of the storage well and from 200 to 400 keV at 10^3 Rh^{-1} and 10^7 n. $cm^{-2} \cdot s^{-1}$ in the reactor channel. Furthermore, the detection of a luminous reference pulse corresponding to 200 keV (NaI) is only perturbed at values of above a few hundred Rh^{-1} by the γ radiation alone, and above 5×10^6 n. $cm^{-2} \cdot s^{-1}$ and ~500 Rh^{-1} in the reactor channel. The dispersion of these results is of the order of 2 for the 8 tubes tested. (auth)

34551 (N-66-32131) DESIGN, DEVELOPMENT, FABRICATION, AND DELIVERY OF IMPROVED MOS TRANSISTORS. Final Report, May 21, 1965–May 21, 1966. Schlegel, Earl S. (Philco Corp., Lansdale, Pa.). June 1966. Contract NAS8-11926. 234p. (NASA-CR-76639). CFSTI.

The causes of instability, high threshold voltage, and gamma radiation sensitivity in MOS transistors were studied. A literature search showed the behavior of sodium to be a cause of instability. Tritium introduced into the oxide as tritiated water did not move in an applied field at high temperatures. Methods were developed for minimizing oxide contamination to produce stable oxides. Investigations to determine the various sources of instability, showed that alkali ion instability can be due to water used in a wet oxidation, the metalizer, or the etching or rinsing solutions used before metalization of the oxide. Reducing the positive charge in the oxide makes it possible to operate transistors at lower power levels and to design transistors less likely to fail due to shorts through the oxide. Techniques which lowered immobile charge densities include the use of different silicon orientations, the use of vapor plated oxides, thermally growing the oxide at a lower temperature, heat treating, or nickel plating the wafer underside followed by baking. Radiation resistance was independent of whether the oxide was thermally grown or vapor plated, and independent of silicon orientation, mobile ion content, irradiation temperature, and silicon conductivity type. (STAR)

34552 (N-67-17969) A STUDY OF THE RELIABILITY OF ELECTRONIC COMPONENTS IN A NUCLEAR-RADIATION ENVIRONMENT. VOLUME I. RESULTS OBTAINED ON JPL TEST NO. 617, PHASE II. Hanks, C. L.; Hamman, D. J. (Battelle Memorial Inst., Columbus, Ohio). June 1, 1966. Contracts NAS7-100; JPL-950458. 263p. (NASA-CR-81652). CFSTI.

For Jet Propulsion Lab., Pasadena, Calif.

A program was conducted to investigate and provide a measure of the effects of long-term nuclear exposure on the reliability of many types of electronic parts. The radiation environment considered was a total exposure of 10^{15} n cm^{-2} having energies above 0.1 MeV and 10^7 rads carbon of gamma rays. In addition, it was necessary to take into account the fact that the parts might also be subjected to the high vacuum of space and a possible maximum temperature of 100°C. Five sets of conditions were chosen for the test. (TSS) (TAB)

34553 (N-67-19914) ULTRASONIC TEMPERATURE MEASURING DEVICE. Quarterly Progress Report. Lynnworth, L. C.; Carnevale, E. H. (Parametrics, Inc., Waltham, Mass.). Jan. 1967. Contract NAS3-7981. 12p. (NASA-CR-72157; QPR-6). CFSTI.

Rhenium wires, previously irradiated to 8.7×10^{19} integrated thermal flux and 2.6×10^{19} integrated fast flux, were annealed and ultrasonically tested in vacuum up to ≈4000°R, together with nonirradiated rhenium control wires. Sound velocities were measured during heating and cooling. These control wire and irradiated wire velocity data exhibited no significant systematic differences. Structural or compositional radiation effects due to the radiation levels were negligibly small. The scatter in these velocity data corresponds to uncertainties in ultrasonically determined temperatures as follows: near 2000°R, ±2%; near 3000°R, ±1%; near 4000°R, less than ±1%. Two nonirradiated rhenium wires, one annealed and one not annealed, were tested while being heated up to ≈5500°R. Up to 4000°R, i.e., before the second wire became annealed, the two ultrasonically indicated temperatures differed as follows: near 2000°R, 10%; near 3000°R, 8.5%; near 4000°R, 2.5%. Above 4000°R, annealing brought the two ultrasonically indicated temperatures into closer agreement: near 5000°R, ½%; near 5350°R, better than ½%. (auth) (STAR)

34554 MECHANISM FOR RADIATION-INDUCED LATCHUP IN A MICROCIRCUIT. Caldwell, R. S.; Bowman, W. C.; Folsom, J. A. (Boeing Co., Seattle). pp 28-9 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

In addition to the usual ionization and permanent damage produced by radiation in micro circuits, occasionally a latchup phenomenon is exhibited. This latchup condition is triggered by the ionization pulse and represents a state in which the circuit maintains a fixed output voltage level independent of the normal input signals. Latchup was observed in a Norden NM1006 differential amplifier due to a 10-MeV dectron pulse (20nsec, 3×10^{9} r/sec) and detailed studies of the phenomenon are described. (B.G.D.)

34555 EFFECT OF SPACE RADIATION ENVIRONMENT ON MICRO-POWER CIRCUITS USING BIPOLAR, JUNCTION-GATE, AND INSULATED-GATE EFFECT TRANSISTORS. Stanley, A. G. (Massachusetts Inst. of Tech., Lexington). pp 30-1 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

The performance of micro-power circuits used in space vehicles, due to the lack of available power from solar cells, is dependent on the performance of microcircuits such as low-level bipolar transistors, junction-gate FET's, and insulated-gate FET's. An investigation was undertaken to determine the performance characteristics of these microcircuits in a radiation environment. (B.G.D.)

34556 DOSE RATE DEPENDENCE OF SURFACE RADIATION DAMAGE EFFECTS IN PLANAR SILICON DEVICES. Mitchell, J. P. (Bell Telephone Labs., Whippany, N. J.). pp 32 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

An investigation of dose rate effects on p-channel enhancement MOSFET's was carried out using ^{60}Co gamma rays, x rays, and low energy electrons. The positive charge buildup in the oxide was observed by monitoring the turn-on voltage of the transistors and the C–V characteristics of the gate-to-substrate capacitance. (B.G.D.)

34557 COMPUTERIZED MODEL FOR RESPONSE OF DEVICES TO A PULSE OF IONIZING RADIATION. Nichols, D. K.; Alexander, J. H.; Choy, S. C.; Van Lint, V. A. J. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). pp 34-5 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

A computer program was formulated and used to follow the flow of electrons and holes in a one-dimensional p-n junction devices in order to study its response to pulsed ionizing radiation. (B.G.D.)

34558 SCEPTRE AND COMPONENT EQUIVALENT CIRCUITS. Bohan, W. A. (IBM Corp., Owego, N. Y.). pp 36 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

A system of computer programs SCEPTRE (System for Circuit Evaluation and Prediction of Transient Radiation Effects) which automatically calculates the dc initial conditions and the transient response of a circuit from a description of the circuit topology, element values, and forcing functions is described. (B.G.D.)

34559 SURVEY OF RADIATION EFFECTS IN METAL–INSULATOR–SEMICONDUCTOR DEVICES. Zaininger, K. H. (RCA Labs., Princeton, N. J.); Holmes-Siedle, A. G. RCA Rev., 28: 208-40(June 1967).

Unlike the solar cell and n-p-n transistor, the MIS device does not sustain a degradation as the principal effect of exposure to nuclear radiation. Instead, the MIS device undergoes a change of operating region. The change is in the nature of a parallel shift of the characteristic curve of the device, and is produced by the trapping of radiation-excited holes within the 2000-Å insulator and the consequent buildup of a fixed "bulk space-charge" in the insulator. Less significant changes under radiation are variations in the shape of the characteristic curve and increased leakage current, which are effectively degradations. The authors discuss the physics of radiation effects in MIS devices is discussed and methods of minimizing these effects are recommended. (auth)

LIFE SCIENCES

Biochemistry, Physiology, and Molecular Biology

Refer also to abstracts 34656, 34739, 34768, 34786, and 34841.

34560 (AD–636652) RADIONUCLIDE PRODUCTION AND EFFECTS OF NUCLEAR REACTIONS ON DOSE FROM 193 MeV PROTONS STOPPED IN TISSUE. Scientific Report No. 2. Jung, Bo (Uppsala Univ. (Sweden). Gustaf Werner Inst. for Nuclear Chemistry). Nov. 1964. Contract AF 61(052)-740. 37p. CFSTI

The contribution to the absorbed dose in tissue-equivalent material from secondary ionizing particles produced in nuclear reactions in the stopping of 193 MeV protons was estimated as a function of penetration depth. The yield of radionuclides of sufficient half-life to permit detection was calculated. The calculations are based on a literature survey of empirical cross sections for proton-induced reactions in oxygen, carbon, and hydrogen. (auth)

34561 (AD–639192) THE EFFECTS OF IONIZING RADIATION ON OXIDATION STATES OF BIOLOGICAL SYSTEMS. Final Report, July 1965–July 1966. Johnson, Donald E.; Register, James W. Jr.; Storey, William H. Jr.; Bollinger, James N. (Southwest Research Inst., San Antonio, Tex. Dept. of Physical and Biological Sciences). July 31, 1966. Contract AF 41(609)-2816. 54p. CFSTI.

Changes in the oxidation state of biological systems as a function of ionizing radiation were studied by measuring the activity of two metalloenzymes and by evaluating electron spin resonance signals produced by mitochondria. The specific activity of liver cytochrome oxidase and xanthine oxidase was not altered in mice exposed to total-body irradiation of 150 to 22,500 rad. Iron (Fe(II)), molybdenum (Mo(V)), and free radicals (probably flavoquinones) yielded the most predominant signals in electron spin resonance analysis of liver mitochondria isolated from both irradiated and control mice. Both the electron spin resonance and cytochrome oxidase data suggest that the electron transport system is not damaged by the levels of ionizing radiation used in this investigation. The fact that molybdenum electron spin resonance signals occur in the mitochondrial preparations and that preliminary data indicate this metal undergoes oxidative changes due to radiation indicates the need for more extensive investigation of the relationship between this metal and ionizing radiation. (CFSTI)

34562 (BMwF-FBK-66-33) LOKALISATIONSDIAGNOSTIK MIT ^{99m}Tc. (Pertechnetate-99m Localization in Man). Boerner, W.; Moll, E. (Wuerzburg Univ. (West Germany). Nuklearmedizinische Abt.). Nov. 1966. 18p. (In German). Dep.

Technetium-99m, which is easily obtained by elution of the parent nuclide ^{99}Mo, was found to be especially suitable for scanning of the brain, thyroid gland, and salivary glands. Comparison of the ^{99}Tc with conventionally used radioisotopes revealed that the radiation dose could be reduced to a minimum; the resolution for scintigraphy was found to be better when ^{99}Tc was used. By application of ^{99m}Tc-pertechnetate it was possible to scan the salivary glands with a very low radiation dose to the patient. (auth)

34563 (RLO–1927-17) THE MEDIATION OF IMMUNOSUPPRESSION BY DEUTERIUM OXIDE AND HYPERBARIC OXYGEN. Progress Report. Siegel, Benjamin V. (Oregon Univ., Portland. Medical School). May 18, 1967. Contract AT(45-1)-1927. 13p. Dep. CFSTI.

Progress is reported on studies on the effects of hyperbaric oxygen treatment over a period of 130 days and the effect of drinking heavy water (15 to 45% of drinking water) on immune responses in mice. Results indicated that the mouse can readily stand long-term intermittent hyperbaric oxygen treatment. Mice drinking 15 or 30% heavy water for 20 days before immunization showed no effect on hemolytic plague number, but 45% D_2O induced a marked depression in plague number. A list is included of eleven publications during the period covered by this report. (C.H.)

34564 (USNRDL-TR-67-62) ASSOCIATION OF NEUTRAL DEOXYRIBONUCLEASE WITH CHROMATIN ISOLATED FROM MAMMALIAN CELLS. Swingle, Karl F.; Cole, Leonard J.; Bailey, J. Stanley (Naval Radiological Defense Lab., San Francisco, Calif.). May 29, 1967. 22p.

Nuclei prepared from spleen cells by a variety of published procedures retained a deoxyribonuclease (DNase) which caused a partial degradation of the nuclear DNA when the nuclei were incubated in the presence of divalent cations. Well-washed chromatin prepared from disrupted nuclei of either spleen or liver retained the DNase, but the soluble nucleoprotein was free of it. The latter preparation was also resistant to attack by added DNase I. The nuclear DNase was shown to be of the DNase I type, which produces 3′-hydroxyl-terminated fragments of DNA. X irradiation of washed nuclei in vitro did not alter their susceptibility to degradation by their endogenous DNase. Chromatin from free thymocytes did not contain endogenous DNase I activity. (auth)

34565 X RADIATION INFLUENCE ON HYPERAMINATION IN PLANTS. Grebinskii, S. O.; Fornyak, N. M.; Gargola, M. S. (Lvov State Univ.). Radiobiologiya, 6: 631-2(1966). (In Russian).

An attempt was made to find the relation between the effects of radiation on the growth and respiration of the sprouts and leaves and the activity of the glutamate-pyruvate aminotransferase system. Pea seedlings of various ages and corn leaves were x-irradiated with 1000 R/min. Tabulated data show that the radiosensitivity of the glutamate-pyruvate system in young leaves is greater than in the mature leaves. The aminotransferase activity in young leaves was almost completely inhibited at 25 Ci dose and in mature leaves at 100 kR doses; however, radiation doses of 1 to 15 Ci slightly stimulated superamination in leaves. Experiments with pea seed showed that the aminotransferase activity was inhibited at 0.5 Ci. A complete inhibition was reached at doses higher than 10 Ci. The radiation dose of 10 Ci inhibits the growth and respiration of sprouting pea seeds, consequently, neither the stimulation nor the inhibition of the plant growth is directly related to the disturbance of the glutamate-pyruvate (aminotransferase) system though the latter plays an important part in amino acid exchange. (R.V.J.)

34566 DNA SYNTHESIS IN MIXED CULTURES OF DOG LEUKOCYTES: DIFFERENTIAL EFFECT OF X RADIATION AND FREEZE-THAWING ON CELLULAR ISOANTIGENICITY. Main, Raymond K.; Cole, Leonard J.; Jones, Marjorie J.; Haire, Henry M. (Naval Radiological Defense Lab., San Francisco). J. Immunol., 98: 417-24(Mar. 1967).

A marked induction of DNA synthesis occurred in 50 : 50 mixed cultures of peripheral blood leukocytes derived from sets of allogenic (beagle and mongrel) normal dog donors. DNA-synthetic activity attained a maximum value at the 6th day followed by a steady decline thereafter. In leukocyte cultures of cells isolated and mixed on the same day, considerable DNA synthesis occurred at time 0. These values declined at 18 hr and 2 days, and then rose later, on day 4. Incubation of individual cell suspensions for 18 hr prior to mixing eliminated the elevated zero time synthesis. X irradiation (2500 rad) of one (or the other) of the cell components of the mixture changed the reaction from a two-way to a one-way immunologic reaction. When one (or the other) of a pair was frozen (–196°C) and thawed (37°C) 3 times and momentarily homogenized before mixing with intact allogenic leukocytes, no induction of DNA synthesis occurred. These results suggest that leukocyte isoantigenic factors are not inactivated or destroyed by x irradiation and can induce DNA synthesis in allogenic leukocytes; whereas, they are labile to freeze-thawing. (BBB)

34567 PAIRED STIMULATION POTENTIATION OF CAT PAPILLARY MUSCLES IN STRONTIUM-CONTAINING MEDIA. Brutsaert, D. (State Univ., Ghent). Arch. Int. Pharmacodyn. Therap., 166: 188-90(Mar. 1967).

The mode of action of the Sr ion in regard to frequency and paired stimulation potentiation of muscle was studied. Isolated cat papillary muscles were suspended in a Krebs–Ringer solution in which all Ca ions were replaced by Sr ions (5 mEq/l). Observations both on isotonically and isometrically contracting papillary muscles at both 22 and 34°C indicated that substitution of all Ca ions with an equivalent amount of Sr ions abolished all potentiating mechanisms that resulted from irregular rhythms. The only adaptation mechanism left in the myocardium consisted of a frequency potentiation that depended upon the overall number of contractions per unit of time with no regard as to whether they were produced at regular or at irregular intervals. On transition to paired stimulation the remaining frequency potentiation resulted in a striking shortening of the total duration of the contraction (velocity staircase) at all frequencies and in a slight additional increase of the amplitude of the contractions (force staircase) on the ascending portion of the staircase; in a Sr-containing solution the staircase was shifted towards the lower frequencies. Another finding on transition to paired stimulation in a Sr medium was that the second contraction of each pair during paired stimulation always exceeded the regular beat both at rested state contractions and at frequencies on the ascending portion of the staircase; at higher stimulation rates both the regular and the extrasystolic

beat attained the same amplitude. The findings implied that Sr can substitute for Ca in its cumulative effect on the contractile elements, but not in regard to its property of adapting contractility from beat-to-beat, as encountered in postextrasystolic and paired stimulation potentiation. Thus, Sr ion did not replace Ca completely in its membranous action or in its distribution at the different specific sites of the sarcotubular system. (BBB)

34568 DYNAMIC PARAMETERS OF MYOCARDIAL CONTRACTILITY UNDER INFLUENCE OF CALCIUM AND STRONTIUM. de Hemptinne, A.; Weyne, J. (State Univ., Ghent). Arch. Int. Pharmacodyn., 166: 184-7(Mar. 1967).

The influence of increasing Sr concentrations and of partial substitution of Sr by Ca on the contractility of atrial strips and papillary muscles of the cat was studied. Three concentrations of Sr were studied (2.5, 5, and 10 mmole/l). The twitch tension that developed progressively increased with increasing Sr concentration. A direct linear relationship was found between both the steady-state developed twitch tension and the steepness of the contraction and the logarithm of the Sr concentration. The time to peak tension varied inversely to the logarithm of the Sr concentration. The total duration of contraction did not show a systematic modification in function of the Sr concentration. After a steady state was reached in a 2.5 mM Sr solution, progressive substitution of Sr by Ca, keeping the total concentration of both ions constant, had a marked negative inotropic effect. A minimum was reached when the bathing medium contained 20% Ca and 80% Sr. Increasing concentrations of Ca or Sr had qualitatively comparable influences on the dynamic parameters of the cardiac contraction. Strontium, however, seemed to be less efficient in activating the contractile mechanism as it depressed the speed of the contractile process and as high concentrations of Sr antagonized to a minor extent the positive inotropic effect of cooling than high concentrations of Ca. (BBB)

34569 STUDIES ON THE EFFECT OF INTERFERON ON THE FORMATION OF ANTIBODY IN MOUSE SPLEEN CELLS. I. SURVIVAL OF SPLEEN CELLS IN CULTURE AND PRESERVATION OF CELLULAR FUNCTION. Mazzur, Scott R. (New Jersey State Dept. of Health, Trenton); Ellsworth, Barbara; Paucker, Kurt. J. Immunol., 98: 683-8(1967).

Methods are described for culturing spleen cells in vitro and demonstrating preservation of their function in irradiated mice. Such recipient mice had sustained 500 R of whole-body x irradiation (200 kV) 1 to 2 days prior to transfer. Maintenance of mouse spleen cells in vitro was achieved by means of a rabbit kidney cell feeder layer. Measuring cell viability by trypan blue exclusion demonstrated that survival of spleen cells after 24 hr in culture was improved from 50% to greater than 90%. Functional integrity of spleen cells cultured during that time interval was unimpaired as measured by the production of interferon and synthesis of antibody on transfer to the irradiated recipient mice. However, the ability to form antibody plaques on agar was reduced, though not abolished, by incubation of spleen cells in vitro. (BBB)

34570 EXPERIMENTAL STUDIES FOR THE EFFECTS OF ^{95}Zr–^{95}Nb ON ALBINO RATS. REPORT 1. DISTRIBUTION OF ^{95}Zr–^{95}Nb AMONG ORGANS AND AUTORADIOGRAPHIES OF TIBIA FOR SUBCUTANEOUSLY INJECTED ALBINO RATS. Morishige, Toshiko (Kyushu Univ., Japan). Nippon Eiseigaku Zasshi, 21: 306-12(Oct. 1966). (In Japanese).

As previously reported ^{95}Zr–^{95}Nb were detected in fallout and vegetation in consequence of the nuclear explosion. To determine biological effects on animals, ^{95}Zr–^{95}Nb were quantitatively injected subcutaneously in rats. The rats were sacrificed at 5 hrs, 24 hrs, 7 days, 14 days, 28 days, and 63 days after administration. After that, the distribution of ^{95}Zr–^{95}Nb was determined in main organs and tissues as well as in urine and feces. Autoradiographs of tibia were taken by macro-contact in order to observe locality and turnover for ^{95}Zr–^{95}Nb in the tibia. Activity of ^{95}Zr–^{95}Nb was highest in the tibia. The next most radioactive tissue was an upper incisor. Radioactivities in other organs were approximately the same on the 63rd day as a result of biological turnover and excretion. Excretion of ^{95}Zr–^{95}Nb in both urine and feces of experimental rats occurred primarily within 24 hrs after injection. After that, the amounts of ^{95}Zr–^{95}Nb excreted in urine and feces per 24 hrs gradually decreased day by day and remained at about same level from the 14th day to the end of the experiments. Contents were generally larger in urine than in feces throughout the experimental period. Zirconium-95 and ^{95}Nb were deposited into a part of metaphysis close to epiphyseal line on the 5th day and consequently were accumulated into metaphysis rather than into both epiphysis and diaphysis. On the 14th day, they were released from the metaphysis close to epiphyseal line, but epiphyseal deposits were not removed. Deposits were found in the epiphysis on the 63rd day. (TSS) (NSA of Japan)

34571 ALTERATION OF THE INCORPORATION OF ^{131}I IN THE CHICKEN EGG. Pena, H. G.; Barth, K. M.; Kessler, W. V.; Plumlee, M. P.; Christian, J. E. (Purdue Univ., Lafayette, Ind.). Poultry Sci., 46: 426-9(Mar. 1967).

Potassium iodide, potassium perchlorate, and pilocarpine nitrate were tested for their ability to alter ^{131}I deposition in the chicken egg. The peak deposition was 2.8% in controls and occurred 4.3 days after dosing. Except for the first day, the deposition in the whole egg was a function of the deposition in the yolk throughout the experiment. The albumin was largely responsible for the total deposition in the whole egg laid during the first day. The ^{131}I deposition values of the yolk were slightly higher than those of the whole egg. The peak depositions of ^{131}I for the potassium iodide and pilocarpine nitrate treated groups occurred at about the same time as the peak deposition for the control group. Potassium perchlorate caused a 91% decrease in ^{131}I deposition in the whole egg, and a 68% decrease was obtained with potassium iodide. Pilocarpine nitrate did not significantly alter deposition. When a combination of potassium iodide and potassium perchlorate or potassium iodide, potassium perchlorate, and pilocarpine nitrate was present, the results showed distinctly the effect of potassium perchlorate, independently of the completely overshadowing, the effects of other agents. The ^{131}I depositions in the albumins of the treated birds were not significantly altered. (BBB)

34572 ACRIFLAVINE-INDUCED IMMUNOLOGICAL PARALYSIS: THE EFFECT OF VARYING ANTIGEN DOSES. Kraft, S. C. (Univ. of Chicago); Samuelson, J. S.; Farr, R. S. Immunology, 12: 53-62(Jan. 1967).

Acriflavin induces a degree of prolonged immunological paralysis to bovine serum albumin (BSA) and minimally prolongs the survival time of allogeneic skin grafts in adult rabbits. The mechanism of action of acriflavin appears to be different from that of x irradiation, alkylating agents, and 6-mercaptopurine (6-MP) because acriflavin does not produce lymph node or bone marrow suppression and the limiting toxicity is renal damage. High rather than low doses of antigen enhance immunological paralysis in adult animals following x irradiation or 6-MP treatment. The effect of varying doses of antigen on acriflavin-induced immunological paralysis was studied and compared with that of x rays and 6-MP. Acriflavin induced more profound suppression to subsequent doses of antigen when the initial antigen dose was 10 mg rather than 100 mg. Control animals initially receiving 1 or 1000 mg BSA had lower mean antibody responses to subsequent BSA injections than controls initially receiving 10 or 100 mg BSA. Acriflavin-treated animals initially receiving 1 or 1000 mg BSA showed an impaired capacity to respond to BSA in addition to that induced by the low or high antigen doses per se, although the 1000 mg BSA acriflavin-treated animals did not exhibit a profound degree of immunological paralysis. These findings are contrary to what would be expected if acriflavin were acting in a manner comparable to x irradiation or 6-MP treatment. Acriflavin may act by potentiating the mechanism of immunological unresponsiveness which follows low doses of soluble protein antigens, rather than operating on the mechanism which induces immune paralysis following the administration of massive doses of BSA to normal animals. (BBB)

34573 DISTRIBUTION OF LABEL IN GUINEA PIG HAIR AND SKIN FOLLOWING ^{125}I-ALBUMIN ADMINISTRATION. Anderson, R. S.; Tabachnick, J.; Song, C. W. (Albert Einstein Medical Center, Philadelphia). Dermatologica, 134: 84-94 (1965).

Since radioiodinated serum albumin is widely used clinically, such as for blood and plasma volume determinations, its fate in the body is important. When the radioiodinated albumin is degraded, the radioiodide which is released is, for the most part, rapidly cleared from the body by the kidney. However, hair is known to concentrate iodide and therefore could be a site of deposition of the label. An investigation was made of the distribution of label in the hair and skin of normal guinea pigs following intracardiac injection of ^{125}I-serum albumin. The skin and hair were shown to be important reservoirs of ^{125}I-serum albumin. Significant amounts of the isotope were present in the skin by 1 hr, and on the hair 6 hr after injection. Radioactivity in the skin was both intra- and extravascular; labeled products probably reached the hair via the sebum. An increasing level of radioactivity (per g) from dorsal to ventral region was observed in the hair, reflecting differences in surface area available for distribution. This gradient was not evident when the radioactivity was expressed as cpm on hair per unit area of skin, suggesting a uniform rate of sebaceous secretion over the entire animal. The concentration of label per g did not vary in the skin; however, the cpm per unit area of skin differed significantly, the dorsal value being greater than those of the flank or ventral regions. The high degree of vasculation associated with actively growing (anagen) hair in the dorsum might cause this tissue's relatively high radioactivity per unit area. (BBB)

34574 STUDY OF THE IN-VITRO RADIATION SENSITIVITY OF RED BLOOD CELL CATALASE. Zsebok, Zoltan; Hernady, Tibor (Medical-Radiological Research Group, Budapest. Medical Univ., Budapest). Magy. Radiol., 18: No. 2, 68-71 (Apr. 1966). (In Hungarian).

Experiments on radiation effects on erythrocyte catalase are reported. It is concluded that there is no direct radiation damage to red blood cell catalase in the course of treatment of patients or from the doses most frequently used for irradiation in animal experiments. Some fundamental concepts are discussed with respect to the dilution effect observed in the course of experimental irradiation and to the phenomenon of dose-dependent radiosensitivity. (JPRS)

34575 STUDIES ON DEPOSITION OF ^{90}Sr ON TEETH. Suzuki, Shigetaka (Nippon Dental Coll., Japan). Shigaku, 53: 227-49(Oct. 1965). (In Japanese).

Male rats weighing about 150 g were previously administered fluorine to accelerate ^{90}Sr-deposition or vitamin D or parathyroid hormone to inhibit its deposition and then $^{90}SrCl_2$ was administered, to examine ^{90}Sr deposition in their front teeth, molars, and thigh bone. In the in vitro experiment, where ^{90}Sr was mixed with fluorine and enamel powder, ^{90}Sr reacted with fluorine and rapidly deposited on the enamel substance until about the 5th day. The amount deposited was nearly proportional to the amount of fluorine in the range of NaF 1 to 20 mg. In the in vivo experiment the groups administered 5 mg and 10 mg of NaF had ^{90}Sr depositions 1.0 to 1.5 times as large as the control group; the deposition was larger in the upper jaw than in the lower jaw, and also in the front teeth than in the molars both in the upper and lower jaw. When over 30 mg of NaF was administered, ^{90}Sr deposition decreased and became the same as in the control. When vitamin D was administered in large quantities, ^{90}Sr deposition in the front teeth was the same as in the control, but in the molars and the thigh bone, it was somewhat decreased. In the case of small doses of vitamin D the deposition was increased in the front teeth, whereas it was remarkably inhibited in the molars and the thigh bone. When parathyroid hormone was administered in large quantities it decreased in the front teeth, but there was no change in the molars and the thigh bone. In case of small doses of the hormone, the deposition tended to increase in the front teeth, whereas it was considerably decreased in the molars and the thigh bone. (NSA of Japan)

34576 EFFECT OF GAMMA IRRADIATION ON THE ENZYMATIC ACTIVITY OF ACTOMYOSIN: ITS POSSIBLE MECHANISMS. Coelho, Rose (CEN, Saclay, Gif-sur-Yvette, France). Radiat. Res., 31: 408-14(July 1967).

The enzymatic activity of actomyosin was measured in 0.6M KCl, with $CaCl_2$, 1×10^{-3}M, used as an activator. Gamma irradiation from ^{60}Co was performed on actomyosin solutions containing 0.3 to 4.2 mg of protein per milliliter. For increasing doses, the enzymatic activity of actomyosin solutions irradiated at fixed concentration is enhanced up to 80% above the control value. Higher doses bring about a progressive inhibition of enzymatic activity. This effect is observed, whatever the protein concentration at the time of irradiation. However, the dose at which maximum activation is observed decreases linearly with increasing dilution of the enzyme. The effect of γ rays on this protein in solution is thus indirect. The loss of SH groups in irradiated actomyosin was measured simultaneously with enzymatic activity. The high activation observed cannot be accounted for by the very small loss of SH, observed under the same experimental conditions. Total SH groups, as titrated in the presence of urea, disappear at a faster rate than accessible SH groups titrated without previous denaturation of the protein. This probably reflects partial unfolding of actomyosin under the effect of γ irradiation. (auth)

34577 INFLUENCE OF DTPA THERAPY ON LONG-TERM EFFECTS OF RETAINED MONOMERIC PLUTONIUM: COMPARISON WITH POLYMERIC PLUTONIUM. Rosenthal, Marcia W.; Lindenbaum, Arthur (Argonne National Lab., Ill.). Radiat. Res., 31: 506-21(July 1967).

In mice given a single intravenous injection of 2.6 μCi of monomeric ^{239}Pu(IV) per kilogram, 30% was in the bone from 6 to 90 days, and 21% at 300 days; 82% of the mice had at least one malignant bone tumor at death. In a second group receiving the calcium form of diethylenetriaminepentaacetic acid (DTPA) daily for 12 days, beginning 3 days after plutonium, the skeletal plutonium was reduced to 14% of the injected amount, and the final tumor incidence was 75%. In a third group, in which DTPA treatment was initiated 1 hour after plutonium, the skeletal burden was reduced to 7% of the injected amount, and the final tumor incidence was 60%. Only 1% of DTPA-control mice had a bone tumor. Average survival times after injection in these four groups were 361, 450, 556, and 650 days. The death rate of mice with bone tumors increased both with age and with time elapsed after plutonium; it decreased with decreasing plutonium concentration in bone after DTPA. DTPA removed approximately equal fractions of plutonium from all bones. Of all the bones, the plutonium concentration in the femur most closely represented the skeletal average. Monomeric plutonium was more carcinogenic in bone than an equal concentration of polymeric plutonium, probably because of differences in microscopic localization. (auth)

34578 BEHAVIOR OF ^{237}Np IN THE ANIMAL ORGANISM AND SOME PROBLEMS OF ITS BIOLOGICAL EFFECTS. Kreslov, V. V.; Libinzon, R. E. (Inst. of Biophysics, Moscow). Radiobiologiya, 6: 837-41(1966). (In Russian).

In view of the increasing use of neptunium in science and technology, the behavior of ^{237}Np in the rat organism was studied after a single intravenous injection of radioactive neptunium nitrate; the biological effects of this element were also studied. Neptunium-237, injected intravenously as the nitrate, was found to enter the blood stream rapidly and be accumulated chiefly in the skeleton, liver, and kidneys; the maximum content of the isotope in these organs was 34.7, 10, and 6.5%, respectively. After one month, the elimination of neptunium-237 from the skeleton occurred with an effective half life of 82.5 days; the radioelement accumulated on the third day was eliminated from the liver with two half-lives: 4.6 days (54.3%) and 45.6 days (45.7%); after three days the isotope was eliminated from the kidneys with T_{eff} approximately 82.5 days. The main route of elimination of neptunium from the rat was via the urine, especially during the first hours. Neptunium-237, injected intravenously in a dose of 1 μCi (1.5 mg) per rat, proved to be highly toxic. Approximately 50% of the animals died on the third to seventh day following the injection; autopsy revealed severe liver damage (acute dystrophy) and kidney damage (necrotic nephrosis). Intraperitoneal injection of ^{237}Np in the same dose did not cause a single death, evidently due to the slower buildup of an injurious concentration of the radioelement in the liver and kidneys. A special experiment was conducted to determine the significance of the valence of the injected neptunium: in the form of NpO_2^+ or NpO_2^{+2}; the samples were too small for definitive conclusions, but preliminary evidence indicates that NpO_2^{+2} is more toxic. (JPRS)

34579 INFLUENCE OF EXPERIMENTAL HYPOTHYROIDISM OF THE RESTORATION OF HEMOPOIESIS IN IRRADIATED RATS. Petrishchev, N. N. (Medical Inst., Leningrad). Radiobiologiya, 6: 844-7(1966). (In Russian).

The influence of experimental hypothyroidism on the restoration of hemopoiesis was investigated on 90 sexually mature male rats. Irradiation was performed with total doses of 300 and 600 roentgens at a dose rate of 42.9 to 44.0 roentgens/min. Hypothyroidism was induced by the administration of 6-methylthiouracil per os in a dose of 20 mg/100 g of body weight during the two-week period after irradiation. Dynamic studies were made of the erythrocyte, reticulocyte, and leukocyte contents in the peripheral blood. A delay of the restoration of erythropoiesis was observed in experimentally induced hypothyroidism following irradiation. Hypothyroidism did not have any appreciable effect upon the restoration of leukopoiesis in the irradiated rats. (JPRS)

34580 ROLE OF POTASSIUM IN THE RADIOSENSITIZING EFFECT OF RIBOFLAVIN. Grigoresku, St.; Nedelku, K.; Nestase, M. (Center of Radiobiology and Molecular Biology, Bucharest). Radiobiologiya, 6: 819-21(1966). (In Russian).

The effects of riboflavin on the dynamics and distribution of radioactive ^{42}K were studied in experiments on 10 dogs. Intravenous injection of riboflavin (dose 20 mg/kg) 10 min before the injection of $^{42}K_2CO_3$ (10 mCi/kg) were found to accelerate the elimination of ^{42}K from the blood, increase the absorption of ^{42}K, from the blood, increase the absorption of ^{42}K, and increase the amount of protein-bound ^{42}K in the blood. The permeability of the erythrocytes with respect to ^{42}K remained unchanged; riboflavin changed the capillary and cellular permeability for potassium. It was concluded that potassium plays a definite role in the radiosensitizing mechanism of riboflavin. (JPRS)

34581 THE EFFECT OF THE THYROTROPHIC HORMONE ON THE ACCUMULATION OF ^{131}I BY THE THYROID GLAND IN THE DEVELOPMENT OF RATS. Pavlovikova, J.; Samel, M. (Endocrinological Inst., Bratislava). Cesk. Fysiol., 15: 102 (Feb. 1966). (In Czech).

Activation of the thyroid gland by exogenous thyrotropic hormone was investigated. In the first hours after injection the accumulation of ^{131}I is lower than in controls; decrease starts after 6 hours and peaks at 9. In all rats up to the age of 16 days the reaction was positive; older ones showed no change, probably because by then the secretion of the endogenous hormone reaches a high enough level. (JPRS)

34582 UPTAKE OF ^{137}Cs BY THE CHLORELLA VULGARIS. Avio, Carlo Maria; Lenzerini, Luciano (Centro Applicazioni Militari Energia Nucleare, Pisa, Italy). Pubbl. Sta. Zool. Napoli, 33: 69-82(1963). (In Italian).

Cesium-137 uptake by Chlorella vulgaris was investigated. When the concentration of Cs was greater than 100 μg/ml, growth was inhibited. A concentration of 7.1×10^{-6} μmole/liter (0.08 μCi/ml) did not affect the rate of growth or the size of the cells. It was concluded that the rate of Cs uptake by Chlorella was a function of the Cs concentration and number of cells. (B.H.S.)

34583 KINETICS OF ENZYME INACTIVATION IN SOLUTION BY IONIZING RADIATION. Sanner, T.; Pihl, A. (Norsk Hydro's Inst. for Cancer Research, Oslo). Eur. J. Biochem., 1: 33-5(Mar. 1967).

Equations were derived without the use of steady state assumptions for the inactivation of enzymes in dilute aqueous solution by ionizing radiation. It was shown that when the exposure times are shorter than the mean life-time of the water radicals, as is frequently the case in experiments involving pulsed radiation, the main part of the enzyme inactivation occurs after the end of the exposure. Total inactivation under such conditions could be described by the same equation as that developed earlier for protracted irradiation. The recent claim that the absolute rate constant for the inactivation of the enzyme can be determined directly from studies of the initial part of the dose inactivation curve was not supported by the present study. The validity of steady state approximations in the treatment of enzyme inactivation in dilute aqueous solution by ionizing radiation was examined. It was concluded that the requirements for the use of the approximation are satisfied when the exposure time exceeds greatly the lifetime of water radicals, as is the case in most enzyme experiments. (BBB)

34584 ULTRAVIOLET LIGHT ALTERATION OF ACID MALTASE ACTIVITY IN EPIDERMIS. Black, Owen Jr.; Anglin, J. Hill Jr. (Univ. of Oklahoma, Oklahoma City). J. Invest. Dermatol., 48: 252-5(Mar. 1967).

Ultrastructural studies of changes in epidermis induced by uv light show an increase in number of irregular dense bodies in the basal cell layer following irradiation of human epidermis. These structures are removed by crude malt diastase but are only partially susceptible to α-amylase digestion. These may be lysosomes or lysosome-like structures. Study of a glycogen storage disease (Pompe's) revealed lysosomal vacuoles containing glycogen in human liver cells. Therefore, attempts were made to determine whether the appearance of the epidermal dense bodies after uv irradiation could be attributed to decreased acid maltase activity which would cause accumulation of glycogen by a mechanism analogous to that of the Pompe's disease. Maltase activity at pH 4.0 (acid maltase) was shown to be present in guinea pig epidermis. This enzyme activity could be separated from another maltase activity at pH 7.0 (neutral maltase). Acid maltase activity was found to be decreased an average of 22% 2.5 hr following uv irradiation. Changes in neutral maltase activity averaged 23% increase. (BBB)

34585 REMOVAL OF INTERNAL CONTAMINATIONS DUE TO RADIOACTIVE SUBSTANCES. Tsuruto, Susumu (Tokyo Univ.). Eisei Kagaku, 12: 1-7(Feb. 1966). (In Japanese).

Removal of strontium from the body (or bone) is discussed. Reduction of the intestinal adsorption can be achieved to some extent by increasing the intake of calcium by the administration of a Ca-type cation exchanger. In removing bone-deposited strontium, chelating agents such as DTPA and TTHA are useful. The mechanisms involved are considered, as well as the properties of the agents when they are actually used. It is also thought possible to remove strontium by disturbing the metabolism of bone calcium and phosphorus. The administration of parathyroid hormone or Ca or P-deficient foods is not effective, but aluminum citrate, capable of preventing the intestinal absorption of phosphorus, appears to be promising. (TSS)

34586 γ-IRRADIATION AFTER EFFECTS ON THE NUCLEOTIDE COMPOSITION OF RNA IN A COTTON PLANT. Khalikov, D. R.; Ibragimov, A. P.; Turakulov, Ya. Kh. Dokl. Akad. Nauk Uz. SSR, 22: No. 2, 54-6(1965). (In Russian).

The amino acid and nucleotide composition of RNA were determined in cotton seeds after γ irradiation at doses of 1, 2, 3, and 6 kR. After alkaline hydrolysis and separation by paper electrophoresis, the nucleotides were determined photometrically. Purine-to-pyrimidine ratios were increased to 1.24 after irradiation. Guanine was increased and uracil was decreased in the RNA. Thymine was decreased in DNA. (W.E.B.)

34587 POLIOVIRUS DOUBLE-STRANDED RNA: INACTIVATION BY ULTRAVIOLET LIGHT. Bishop, J. M.; Quintrell, N.; Koch, G. (National Inst. of Allergy and Infectious Diseases, Bethesda, Md.). J. Mol. Biol., 24: 125-8(1967).

Kinetics of uv inactivation were studied for polio virus and its single- and double-stranded RNA's. Mature polio virus was inactivated more rapidly than the single-stranded RNA derived from it, a discrepancy not adequately explained. The difference between the uv sensitivity of single- and double-stranded RNA resembled that observed between the irradiated single-stranded DNA and the double-stranded replicative form of φX174. As suggested for the φX174 replicative form, the relatively greater uv resistance of double-stranded RNA could be attributed to either a lower rate of photochemical damage in the more ordered structure of the double-stranded molecule, or redundance of information in the complementary strands that would reduce the lethality of uv lesions. Unsuccessful efforts were made to demonstrate photoreactivation of uv-irradiated double-stranded polio virus RNA. These and other studies on the effects of uv light on single- or double-stranded RNA of polio virus indicated that relatively low doses were required for biological inactivation and that at these dose levels no appreciable changes in the character of the absorption spectrum of the molecule and thermal denaturation were detectable. Since there was no evidence for a major host-cell reactivating mechanism, the double-stranded RNA must be more resistant to uv radiation than its homologous single-stranded form. (BBB)

34588 EFFECTS OF ELECTROLYTES, ACETYLCHOLINE, ATP, AND IONIZING RADIATION ON THE PROPERTIES OF MONOMOLECULAR MYOGEN AND MYOSIN LAYERS. Egiazarova, A. R.; Zaalishvili, M. M.; Nadareishvili, K. Sh. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR, 45: 631-8(Mar. 1967). (In Russian).

The elasticity and viscosity of monolayers of myogen A were significantly less than the corresponding mechanical parameters of myosin A and B. The thickness of the monolayers was of the order of 10 Å. In the presence of the ATP molecule (0.04%), myogen monolayers had no elasticity. With an increase in the concentration of the K^+, Ca^{2+}, and Mg^{2+} ions and in the presence of ATP, the viscosity, elasticity, and the potential jump of myosin A and B were appreciably reduced. X irradiation of solutions of myosin A at doses of 20, 50, and 100 R in concentrations of 5 to 35 mg/ml and at doses from 1 to 100 kR at concentration of 1 mg/ml caused a reduction of the elasto-viscous properties and also of the area size and potential jump of the monolayer. At 60 to 75 kR the viscosity and elasticity of monolayers at low surface pressure were equal to the elasto-viscous magnitudes of monolayers of non-irradiated solutions of myosin and at high pressure exceeded it. At doses of 100 kR albumin solutions with concentrations higher than 4 mg/ml formed gels with separation of the liquid phase at small concentration of albumin. (tr-auth)

34589 PAN IRRADIATION AND ENDOGENOUS ERYTHROCYTIC ENZYMIC ACTIVITIES. NOTE 2a. RESEARCH IN VITRO. Blandino, G.; Caruso, P.; Conti, F.; Caponetti, R. (Univ., Messina, Italy). Radiobiol. Radioter. Fis. Med., 21: 377-80(Nov.-Dec. 1966). (In Italian).

Hemolysis of 14 samples of human blood by whole-body x irradiation and measurements of activities of endogenous erythrocytic enzymes prior to and following exposure are reported. Activity of endogenous erythrocytic enzymes was inhibited by irradiation, a finding that confirms the previously observed reduction in numbers of circulating erythrocytes. (auth)

34590 MODIFICATIONS OF OXIDATIVE PHOSPHORYLATION IN THE MITOCHONDRIA OF RATS IRRADIATED IN THE DIENCEPHALON-HYPOPHYSIS REGION. Cenciotti, L.; Sanna, G. (Ospedale Civile, Cesena, Italy). Radiobiol. Radioter. Fis. Med., 21: 390-408(Nov.-Dec. 1966). (In Italian).

In a group of rats irradiated with 3000 R in the diencephalon-hypophysis region, the propriety of the mitochondria in oxidizing various substrates and in combining adenosinetriphosphate was examined. In animals killed after 24 hrs no substantial modification in the controls was noticed. In animals killed after five days a constant reduction in the process of oxidative phosphorylation was clearly evident. Such alteration is connected with the postirradiation functional lesion of the diencephalon-hypophysis region, so much so that an identical situation was noticed in hypophysectomized controls. Considering the radiobiological and physiopathological mechanism that is likely to condition these metabolic modifications, it is suggested that these are caused by a disturbance of the mitochondrial membranes. (auth)

34591 POSTIRRADIATIONAL DISTURBANCES OF THE DISTRIBUTION OF ASCORBIC ACID IN GUINEA PIGS UNDER EXPERIMENTAL HYPOTHYROID CONDITIONS. Dolgova, Z. Ya.; Dolgov, E. G. (Semipalatinsk Medical Inst., USSR). Radiobiologiya, 7: 300-2(1967). (In Russian).

Administration of a single total dose of 600 R to guinea pigs caused reduction of the ascorbic acid content in the liver, spleen, small intestine, cerebrum, adrenal glands, and blood. Previous

administration of a thyrostatic preparation (6-methylthiouracil) prevented that drop in the spleen, small intestine, and blood. The results indicate the importance of hormonal influences of the thyroid gland in the development of disturbances of ascorbic acid metabolism in radiation sickness. (JPRS)

34592 MECHANISM OF THE EFFECT OF ^{32}P IN VARIOUS CONCENTRATIONS ON SOME RADIOBIOLOGICAL PARAMETERS. Pugachevskii, V. P.; Dobrovol'skii, L. A. (Scientific Research Inst. of Labor Hygiene and Occupational Diseases, Kiev). Radiobiologiya, 7: 51-4(1967). (In Russian).

Phosphorus-32 in doses of 2, 20, and 200 μCi was administered to female rats. The fractional deposition of the radioisotope, determined 24 hrs later, decreased with increasing doses in the whole organism and in all organs and tissues of the animals except the brain, in which an increase of deposition with increasing doses was observed. On external irradiation of rats with 200 R of γ rays, the coefficient of deposition of ^{32}P in the whole organism and in individual organs and tissues decreased. The highest effect was observed with local irradiation of the head, a somewhat lesser effect with total-body irradiation. An exception was deposition of ^{32}P in the femur, the coefficient of which increased after local irradiation of the head compared with non-irradiated controls. (JPRS)

34593 CALCIUM AND PHOSPHORUS METABOLISM IN RABBIT BONE UNDER THE EFFECT OF ^{239}Pu. Elkina, N. I. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 42-6(1967). (In Russian).

In a study of normal rabbits, it was established that the Ca and P in the diaphysis of tubular bones was 10 to 34% higher than in the porous part of the bones, while the rate of inclusion of Ca and P, as indicated by experiments with ^{45}Ca and ^{32}P, was 2.3 to 2.8 times lower in the diaphysis than in the porous part. Between the ages of 90 and 635 days, the rate of uptake of Ca and P into the bones decreased by a factor of 2 to 6, while the content of these elements in the bones did not change significantly. On administration of ^{239}Pu in a dose of 2 or 7 μCi/kg to rabbits, the Ca and P content in bone was not altered significantly from the normal. With 7 μCi/kg dose of ^{239}Pu, the rate of uptake of ^{45}Ca and ^{32}P in bone decreased: 30 days after administration of ^{239}Pu to the rabbits, the ^{45}Ca activity was 66% in the diaphysis and vertebrae and 52% in the epiphysis vs. controls, while the activity of ^{32}P was 59% in the diaphysis and 67.5% in the porous part of tubular bones and of vertebrae vs. controls. Between the 30th and 180th day after Pu administration, the rates of uptake of Ca and P showed a tendency to return to normal. On administration of ^{239}Pu at a dose of 2 μCi/kg, changes in the uptake rate of ^{45}Ca and ^{32}P took place at a later time than after administration of the larger dose. The rate of uptake of ^{45}Ca and ^{32}P in osteosarcomas that developed after administration of ^{239}Pu at a dose of 2 μCi/kg was higher by a factor of 9 to 15 and 2 to 16, respectively, as compared with the non-tumorous bone tissue of the rabbits with tumors. (JPRS)

34594 CHARACTERISTICS OF THE METABOLISM OF ^{144}Ce CHLORIDE IN RATS AFTER PARTIAL HEPATECTOMY. Ovcharenko, E. P. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 55-8(1967). (In Russian).

Female rats, on which a 50% hepatectomy had been carried out, were injected with ^{144}Ce chloride with an activity of 0.5 μCi 1, 3, or 6 days after the operation. The concentration of ^{144}Ce in the liver for 24 hrs after administration did not differ from control values for rats with an intact liver. On administration of ^{144}Ce one day after the operation, the isotope was eliminated from the liver at an accelerated rate until the 4th day after the operation, while the elimination on the 5th to 17th after the operation was at a reduced rate vs. controls. On administration of ^{144}Ce on the 6th day after the operation, the elimination of the radioisotope from the liver took place at a reduced rate from the 7th to 22nd day after the operation. Upon regeneration of the liver function, the distribution of ^{144}Ce in the organs and tissues of experimental rats did not differ from that for controls. (JPRS)

34595 PARTICIPATION OF "ACID" DEOXYRIBONUCLEASE (DNA-ase II) IN THE INITIAL BIOCHEMICAL MECHANISMS OF THE ACTION OF IONIZING RADIATION ON ANIMALS. Moskalenko, I. P. (Scientific Research Inst. of Medical Radiology, Kharkov). Radiobiologiya, 7: 31-6(1967). (In Russian).

It was established that a highly polymerized DNA (sp-DNA) is present in tissues and that it is very sensitive to the action of radiation: its elasticoviscous properties are altered immediately after irradiation. It was also established that DNA-ase II is activated in organs sensitive to radiation at an early stage of irradiation. A study was conducted on the role of DNA-ase in the radioinduced degradation of sp-DNA. A considerable DNA-ase activity was found in nuclei isolated from the thymus of normal rats. Incubation of the nuclei with extracts from the spleen of normal rats produced a certain amount of additional degradation of sp-DNA present in these nuclei. Incubation of the nuclei with extracts from the spleen of rats irradiated with 825 R of x rays resulted in still greater degradation of sp-DNA, presumably because of activation of cytoplasmic DNA-ase following irradiation. The viscosity of sp-DNA isolated from nuclei of the thymus of irradiated rats decreased as soon as 1 min after irradiation and continued to decrease to a level denoting complete degradation at 18 hrs after irradiation, while the DNA-ase of the nuclei was affected perceptibly only beginning with the 6th hour after irradiation. The results showed that depolymerization of sp-DNA occurred both because of the direct action of radiation and because of the activation of DNA-ase. (JPRS)

34596 INTERRELATIONS OF CHANGES IN THE CONTENT OF PROTEINS, VITAMINS, AND INORGANIC SUBSTANCES IN THE BLOOD OF IRRADIATED RABBITS. Nikolaev, A. I.; Suleimanova, G. S.; Mukhtarova, F. G. (Scientific Research Inst. of Roentgenology, Radiology, and Oncology, Tashkent). Radiobiologiya, 7: 48-50(1967). (In Russian).

The chemical composition of the blood of rabbits irradiated with 50–2000 R of x rays was studied. The content of inorganic substances in the blood, particularly of K, showed the highest lability on irradiation: it was altered at the lowest doses applied. The level of K increased as soon as the 2nd day on irradiation with 50 to 100 R and continued to increase up to 5 mo after irradiation. At higher doses (300 R), the level of K increased first. This was followed by a decrease in the level of Ca and P and then of the content of vitamins C and PP. On irradiation with 600 to 1200 R, the level of K increased first (3 hrs after irradiation with 600 R), then a decrease in the content of Ca and P followed by a decrease in that of vitamins C, PP, and A was observed, and finally (12 to 24 hrs after irradiation) changes in the protein composition of the blood involving a decrease in albumins and an increase in globulins took place. Some of the animals irradiated with 1400 to 2000 R died within a few hours after irradiation, while those that survived longer exhibited pronounced blood changes. The results indicated that the content of serum proteins, which are the most important substances for the organism, was maintained most effectively by compensatory reactions, while the content of inorganic substances and of vitamins, which are less important, changed first. (JPRS)

34597 THE ACTIVITY LEVEL OF ENZYMES OF THYMIDINEMONOPHOSPHATE (TMP) SYNTHESIS AND DECAY IN IRRADIATED RATS. Belyaeva, E. M.; Vinetskii, Yu. P. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 184-8(1967). (In Russian).

Rats were partially hepatectomized and five hours later were irradiated with doses of 300, 600 and 850 R. Although the thymidylsynthetase activity of regenerating rat liver declined 57, 64, and 66% respectively in the irradiated as compared with operated nonirradiated rats, the activity level of enzymes phosphorylating TMP or its predecessors was the same in both groups. It is concluded that the decrease of TMP that occurs is not determined by the activity of the enzymes catabolizing TMP or its predecessors but is a result of blocking its synthesis from desoxyuridinemonophosphate. (JPRS)

34598 RELATION BETWEEN CALCIUM AND STRONTIUM TRANSPORT RATES AS DETERMINED SIMULTANEOUSLY IN ISOLATED SEGMENTS OF THE PRIMARY ROOT OF ZEA MAYS. Hutchin, Maxine E.; Vaughan, Burton E. (Naval Radiological Defense Lab., San Francisco). Plant Physiol., 42: 644-50(May 1967).

Root segments of Zea mays 55 mm long, were exposed to nutrient containing ^{85}Sr and ^{45}Ca tracers. Translocation rather than uptake was measured, using a newly-designed glass compartmentation system and validated tracer analytic model. Calcium transport from solutions containing between 0.25 and 5.0 mμ Ca was only slightly affected by concentration, but translocation from 0.25 to 0.05 mμ solutions was markedly reduced. Maximum transport of strontium from nutrient containing 0.05 mμ Ca was twice that from 2.5 mμ Ca, and also twice the maximum calcium transported. Thus, under the condition simulating calcium depletion, i.e., 0.05 mμ Ca, greater amounts of strontium were transported. In these cases the solutions also contained stable strontium at concentrations between 0.25 and 5.0 mμ. In simultaneous determinations, the ratio of Sr to Ca moved was exactly equal to the ratio of their concentrations in nutrient solution, and there was no evidence of discrimination. Dinitrophenol reduced transport of Sr and Ca to an equivalent extent, amounting to between 2 and 9% of non-treated control levels. (auth)

34599 TRANSLOCATION OF RADIOACTIVE KINETIN. Lagerstedt, Harry B.; Langston, R. G. (Texas A and M Univ., College Station). Plant Physiol., 42: 611-22(May 1967).

Kinetin has generally been thought to be immobile in plants.

This was confirmed in the case of laminar applications, but not in regard to petiole, vein, or root applications. Radioactivity from kinetin-8-^{14}C (Kn*) moved freely in the vascular system of several types of leaves. This movement was usually distal to the point of application and seemed to occur with the transpiration stream. Basipetal as well as acropetal translocation of radioactive kinetin was achieved in tobacco leaves. The translocated material was extracted from veinal tissue, shown to be radioactive, and to be able to retard senescence. Similar but less decisive results were obtained from agar blocks inserted into the vascular system of leaves receiving Kn* by petiole uptake. A bioassay employing disks from primary bean leaves was developed for the qualitative determination of substances like kinetin which possess the ability to retard chlorophyll breakdown and plant senescence. The use of radioactive kinetin provided a refinement in this bioassay because treated non-senescent areas could be correlated with exposed areas on radioautographs made from dried leaf disks. Root treatments showed that cotton seedlings did not take up Kn* but that similarly treated tobacco seedlings both absorbed and translocated the isotope readily. (auth)

34600 THE PRIMING ACTIVITY OF X-IRRADIATED MAMMALIAN DEOXYRIBONUCLEIC ACID FOR THE DEOXYRIBONUCLEIC ACID POLYMERASE FROM CALF THYMUS. Campagnari, Francesco; Bertazzoni, Umberto; Clerici, Libero (EURATOM, Ispra, Italy). J. Biol. Chem., 242: 2168-71(May 10, 1967).

The ability of x-irradiated calf thymus DNA to prime for the partially purified DNA polymerase from the same tissue was investigated. Solutions of 50 to 400 μg per ml of DNA in 10^{-2} M phosphate or tris(hydroxymethyl)aminomethane buffer, pH 7.0 to 8.0, were exposed to doses up to 2000 R. This treatment had apparently no effect on the primer saturation curves obtained when increasing quantities of DNA were incubated for a standard period with substrates at optimal concentration and in the presence of a constant amount of enzyme. The results have shown that a moderate x irradiation of isolated mammalian DNA does not cause molecular damages affecting the duplication rate of single stranded DNA chains by a base-pairing mechanism, while it is catalyzed by the DNA polymerase from calf thymus in vitro. (auth)

34601 THE ACCUMULATION OF CERTAIN RADIOISOTOPES BY LIVE AND DEAD TISSUES OF FRESH-WATER PLANTS. Kulikov, N. V.; Lyubimova, S. A.; Timofeeva, N. A. (Inst. of Biology, Sverdlovsk, USSR). Radiobiologiya, 7: 271-4(1967). (In Russian).

The moss Drepanocladus sendtneri (Schimp. Warnst.) and hornwort (Ceratophyllum demersum L.) were tested for the accumulation of ^{89}Sr, ^{106}Ru, ^{137}Cs, and ^{144}Ce by live and dead tissues of fresh-water plants, the return of those elements to the medium and their reaccumulation by living plants. Their contents in the plants and water were determined after 2, 4, 8, and 16 days, then the plants and detritus were transferred to pure lake water and re-analyzed after 2, 4, 8, and 16 days. After the 16th day the plants and detritus were replaced by new living plants. The results obtained show that all the elements were released somewhat more strongly from living hornwort than from living moss. Strontium-90 accumulated almost identically in living and dead plants; in the system water-plants (living and dead) equilibrium was achieved for ^{90}Sr in the first two days. Cesium-137 accumulation was about the same in living and dead hornwort and somewhat larger in living than in dead moss. Ruthenium-106 and ^{144}Ce accumulated more strongly in dead than in living plants. (JPRS)

34602 STUDY OF REACTIVE PROTEIN, GLUTAMINE-PYRORACEMIC AND GLUTAMINE-OXALACETIC TRANSAMINASES IN ^{90}Sr ADMINISTRATION. Nevstrueva, M. A.; Shubik, V. M.; Livshchits, R. E.; Lebedev, O. V. (Scientific Research Inst. of Radiation Hygiene, Leningrad). Radiobiologiya, 7: 189-92(1967). (In Russian).

Reactive protein was observed in the blood of rabbits administered ^{90}Sr subcutaneously in doses of 50 and 5 μCi/kg of weight (groups 1 and 2 respectively). The same percentages of positive reactions were found in group 2 and the control group (group 3), but this is explained by the phased character of the appearance of reactive protein in the blood. An increase in glutamine-pyroracemic transaminase activity was observed under the effect of ^{90}Sr, but heightened glutamine-oxalacetic transaminase activity was observed less often. No parallelism was observed between the reactive protein content and the transaminase activity. (JPRS)

34603 INFLUENCE OF ULTRAVIOLET IRRADIATION ON NUCLEOPROTEIN SOLUTIONS. Sklobovskaya, M. V.; Ryabchenko, N. I. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 7: 175-8(1967). (In Russian).

The DNA yield decreases after ultraviolet irradiation of solutions of DNP from calf thymus but not after gamma irradiation at a dose of 50 R or treatment with 0.2 M sodium nitrite. The DNP damage connected with reduction of the DNA yield are intramolecular and can result from damage or from covalent bonding of the DNA with a small number of molecules (3-10) of the protein component of the nucleoprotein complex. (JPRS)

34604 CHANGE OF PEROXIDASE RADIOSENSITIVITY DURING FORMATION OF AN ENZYMESUBSTRATE COMPLEX WITH H_2O_2. Gorbunova, V. G.; Mamedov, T. G. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 7: 167-70(1967). (In Russian).

The peroxidase-H_2O_2 complex has greater radioresistance than free peroxidase; the average $LD_{50} > 1:4$. Upon irradiation of free peroxidase the activity decreases with time and increases with temperature; the same is true of the complex when kept at 0°, but at 18 to 30° the inactivation is moderated somewhat although the resistance of the complex decreases noticeably. Variation of the H_2O_2 concentration at the time of irradiation does not affect the percentage of peroxidase molecules inactivated. (JPRS)

34605 SOME ASPECTS OF THE ACTION OF X RAYS ON CONDENSED DNP SYSTEMS. Martynov, E. V.; Spitkovskii, D. M.; Ivannik, B. P. (Inst. of Experimental Biology, Moscow). Radiobiologiya, 7: 163-6(1967). (In Russian).

Gels of oriented nucleoprotein fila were irradiated with doses of 10 to 100 R and the length, relaxation and flow points of the DNP structures were investigated as a function of the dose. The effects observed are reduced to partial deproteinization of the DNP and, as a result, destruction of the supermolecular nucleoprotein structure. (JPRS)

34606 BIOSYNTHESIS OF LIPIDS AND CHOLESTERINE IN THE SMALL INTESTINES AND LUNGS OF IRRADIATED WHITE RATS. Vinogradova, M. F. (Leningrad State Univ.). Radiobiologiya, 7: 179-83(1967). (In Russian).

X irradiation of white rats at doses of 400, 800 and 1200 R cause substantial changes in the biosynthesis of lipids and cholesterol in the small intestines and lungs. In the small intestine, at 400 R biosynthesis declined but was restored in 72 hours; at 800 R it was not restored in 72 hours but recovery mechanisms were functioning at that time; 1200 R was absolutely lethal. In the lungs there was a clear dependence of biosynthesis on the radiation dose and the time elapsed since irradiation. (JPRS)

34607 INFLUENCE OF FOLIC ACID ON INOSINIC ACID SYNTHESIS IN LIVER CELL HYALOPLASM AFTER IRRADIATION. Khalikov, S. K.; Romantsev, E. F. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 295-7(1967). (In Russian).

The synthesis of inosinic acid in the hyaloplasm of the liver of irradiated pigeons, which is inhibited 10 to 60 minutes after exposure, when there is a folic acid deficiency, and starts to be normalized in 12 to 24 hrs, is greatly intensified by the addition of folic acid, even more than the synthesis of purines when the same quantity of folic acid is added to the liver of healthy birds. (JPRS)

34608 DISTURBANCES OF THE BONDING OF ADRENOCORTIC HORMONES WITH PLASMA PROTEINS IN RADIATION SICKNESS. Fedotov, V. P.; Moroz, B. B.; Pantyushina, N. N. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 306-8(1967). (In Russian).

Corticosterone was determined in the plasma of rabbits at specific intervals after γ-irradiation. The results are tabulated and show an increase of free steroids not bonded with protein and therefore evidently capable of causing a hypercorticoid state even when the hormones in the blood are at a normal total level. A lengthy state of latent hypercorticism can be a factor worsening the clinical course of severe radiation sickness. (JPRS)

34609 THE NATURE OF THE FREE RADICALS IN THE LIPIDS OF IRRADIATED RATS. Kolomiitseva, I. K.; Kayushin, L. P.; Kuzin, A. M. (Inst. of Biological Physics, Moscow). Radiobiologiya, 7: 294-5(1967). (In Russian).

The variation of the concentration of free radicals in the lipids of rat liver and spleen after irradiation was investigated by comparing the EPR (Electron Paramagnetic Resonance) spectra of lipids dry, moist and in alkaline solution. The EPR signal rose sharply upon addition of ascorbic acid to dry samples and to alkaline lipid solution, and it cannot be excluded that the signal in dry lipids is connected with the presence of that acid. It can be said, however, that the increase in the concentration of free radicals in the lipids of irradiated rats is a result of the appearance of some sort of reduced compounds. (JPRS)

34610 MARROW NUCLEIC ACID FRACTIONS, NORMAL AND AFTER IRRADIATION IN VIVO. Kritskii, G. A. (Inst. of Bio-

chemistry, Moscow). Radiobiologiya, 7: 193-8(1967). (In Russian).

Two principal nucleic acid fractions were separated by fractional precipitation from rabbit marrow immediately after irradiation with doses of 2000 and 200 R: a readily-precipitated, high-polymeric fraction containing 30% less normal RNA; in DNA complexes, and a difficultly precipitated and low-polymeric fraction containing over 100% more DNA and 30 to 55% less RNA and residual protein in DNA complexes than normal. The relative content of RNA and residual protein increased in the period of acute radiation sickness (1 to 6 days after irradiation). (JPRS)

34611 THE EFFECT OF IRRADIATION OF WHEAT SEEDS ON THIAMINE BIOSYNTHESIS. Kulesha, Ya.; Moshchinskii, P.; Krokh, E. (Polytechnic Inst., Lodz, Poland). Radiobiologiya, 7: 267-70(1967). (In Russian).

Spring wheat seeds of the variety Ostka Chlopicka were irradiated with doses of 1, 5, and 20 krad at a rate of 200 krad/hr. and then placed in 15 g portions on moistened filter paper on sterile Petri dishes at room temperature in natural illumination for five days. The quantities of dry matter, thiamine, and triaminopyrophosphate were then determined. That of free thiamine changed insignificantly, but the average triaminopyrophosphate increment increased with the dose, being 15% at 1 krad, 60% at 5 krad and 70% at 20 krad. The sugar content rose maximally at 5 krad but was smaller than in the control at 20 krad. (JPRS)

34612 THE MECHANISM OF POSTIRRADIATION ELEVATION OF THE GLYCOGEN LEVEL IN RAT LIVER. Kendysh, I. N.; Fedotov, V. P. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 243-6(1967). (In Russian).

Rats adrenalectomized three days previously and intact rats were: irradiated (550 R); administered cortisone; and irradiated (700 R) and administered cortisone. The results are tabulated and permit the conclusion that radiation-induced intensified synthesis of glycogen in the liver occurs on account of increased sensitivity of the irradiated tissues to the action of adrenocortical hormones and not on account of increased secretion of corticoids. (JPRS)

34613 TWO-PHOTON ABSORPTION IN REDUCED NICOTINAMIDE-ADENINE DINUCLEOTIDE (NADH). Rounds, D. E. (Pasadena Foundation for Medical Research, Calif.); Olson, R. S.; Johnson, F. M. pp 158-9 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2-4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

The relative amount of light absorption by water and by a concentrated (2 mg/ml) solution of reduced nicotinamide adenine dinucleotide (NADH), where the degree of photon scatter was negligible, was measured. A focused ruby laser beam was passed through the solutions that were contained in cylindrical cuvettes; the input and transmitted energies were measured. By plotting the reciprocal of the transmitted energy versus the input energy, it was established that NADH showed an increasing degree of light absorption within the higher photon density range; water showed no such effect. Also treatment of lactate dehydrogenase with laser energy did not change the rate of reaction of the enzyme, but laser exposure of NADH solution alone or in the presence of the enzyme caused a significant decrease in the rate of the reaction. (B.H.S.)

34614 CHARACTERISTICS OF BIOLOGICAL DAMAGE BY LASERS. Barnes, F. S.; Hu, Chia-lun; Lauridson, J. R.; McGibbon, A. L. (Univ. of Colorado, Boulder). pp 164-5 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2-4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

The four kinds of damage that occur in a biological system when laser radiation is adsorbed are characterized. Equations were derived for steady state characterization of damages that occur from shock waves, thermal waves, and vaporization. The fourth kind of biological damage, photochemical change, was studied by determining the changes in the spectral absorption characteristics of laser irradiated hemoglobin. Changes that resulted from interactions of the laser beam with the hemoglobin were different from those that resulted from straight heating. (B.H.S.)

34615 THE MAGNITUDE OF EXCHANGE OF TRITIUM FROM HTO AND DEUTERIUM FROM D_2O IN NORMAL AND INFLAMMATORY TISSUES. Mikulski, Andrzej (Zaklad Patofizjologii Instytutu Reumatologicznego, Warsaw). Acta Physiol. Pol., 18: 453-62(May-June 1967). (In Polish).

The exchange of tritium from tritium water (HTO) and deuterium from deuterium water (D_2O) with unstable hydrogen atoms in biologic materials was studied. Isolated rat muscle tissue was used in the experiments. The degree of exchange of tritium and deuterium in healthy tissues and in tissues from animals with polyarthritis induced by means of Freund's adjuvant was determined. In the case of tritium and deuterium, the value of isotope exchange in healthy tissues under the experimental conditions was 4.0% of the administered doses and was not distinctly changed in tissues with polyarthritic inflammation. The effect of tritium exchange on the error commited when assaying total water by means of tritium water (HTO) was also investigated. It was found that this method gives results 3.7% too high on the average. (auth)

34616 THE LYMPHATIC AND VENOUS PATHWAYS FOR THE OUTFLOW OF THYROXINE, IODOPROTEIN, AND INORGANIC IODIDE FROM THE THYROID GLAND. Daniel, P. M.; Plaskett, L. G.; Pratt, O. E. (Maudsley Hospital, London). J. Physiol. (London), 188: 25-44(Jan. 1967).

The fate of ^{131}I was studied in baboons and cats. They were given radioiodine and, at varying times after the injection, samples of thyroid and nonthyroid lymph and of thyroid venous and peripheral venous blood were collected. The radioactive material in these samples was separated by paper chromatography or by differential precipitation and solvent extraction into 3 main fractions: inorganic iodide, iodoamino acid iodine, and high molecular-weight material (retained at the origin of chromatograms and not extractable by butanol or ethanol). Thyroxine was the main component of the radioactive iodoamino acid iodine in thyroid lymph, in thyroid venous, and in peripheral blood. An unidentified thyronine-^{131}I compound that was frequently found in thyroid lymph and also in blood samples contained an appreciable proportion of the radioiodine. This substance was probably a metabolite of one of the iodothyronines. In addition, iodotyrosines probably accounted for up to 4% of the radioactivity in the lymph and blood samples but radioactive triiodothyronine could be detected with certainty. The lymphatics and the venous system provided alternative pathways for the outflow of ^{131}I compounds from the thyroid gland. These pathways differed in relative importance for different radioiodine compounds. For radioiodoprotein the lymphatic pathway was the important one since there was no appreciable release of this substance into the thyroid venous blood. In the case of inorganic radioiodide, there was no appreciable difference in concentration between thyroid lymph and blood. (BBB)

34617 THE METABOLISM OF STRONTIUM ISOTOPES (^{90}Sr) STUDIED WITH THE MACRO-AUTOGRAPHIC METHOD. (TECHNICAL NOTE). Scoccianti, P.; Viola, S. (Univ., Florence). Arch. "Putti" Chir. Organi Movimento, 21: 316-20(1966). (In Italian).

A method for whole-body autoradiography for study of the distribution of ^{90}Sr is presented, and results obtained with it in mice are described. The animals were given an intraperitoneal injection of 2 mCi/kg body weight, and sacrificed at various intervals by asphyxiation. The carcasses were frozen at -20°C and sectioned longitudinally into 30-μ thick slices on a specially designed microtome. Techniques of autoradiography using Kodirex film and exposures of 6 hr are outlined. Some autoradiographs showing ^{90}Sr distribution in the skeletal system of the mouse, particularly in the vertebrae are shown. The procedure is generally applicable to β-emitting isotopes. One limitation to the technique is its lack of quantitative precision. (BBB)

34618 IMMUNOLOGICAL REACTIVITY IN RADIOCHIMERAS AND ITS CONNECTION WITH IMMUNOLOGICAL TOLERANCE. Shevelev, A. S. Patol. Fiziol. Eksp. Terap., 10: No. 4, 74-9(1966). (In Russian).

Ionizing radiation in lethal doses selectively destroys lymphoid tissue and bone marrow cells, leaving an animal or human body immunologically unprotected. Lethal radiation doses also reduce transplant immunity sharply, facilitating the viability of homotransplants, a fact of great importance in radiation sickness therapy. New tissues can be substituted for partly destroyed blood-forming tissues of an irradiated host. Such tissues consisting of donor tissue plus residual irradiated host tissue are called radiochimeras. Immunological tolerances and mechanisms are being studied to elucidate the processes involved in making successful tissue transplants in adults. Transplants succeed less often in adults than in embryos and infants. Certain antimetabolites mimic the action of ionizing radiation, not only producing nonspecific lowering of immunological reactivity but also inducing transplant tolerance in the affected animal. Longstanding transplants acquire immunity to the enzymes of the host and survive. There appears to be a critical period during which the cells either acquire the immunity and live or fail to become immune and die, producing a transplant failure. Various types of tolerance problems and immunological methods used were also discussed. (ATD)

34619 USE OF THE MOESSBAUER EFFECT TO MEASURE SMALL VIBRATIONS. Brafman, H.; Gilad, P.; Hillman, P.;

Lebenbaum, D.; Wolfsohn, Y. (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Instrum. Methods, 53: 13-21(July 1967).

A technique is described for the measurement of small vibrations (in the Å range at audio frequencies) of small bodies (in the mg range) using the Moessbauer effect. The movement of a Moessbauer source relative to an absorber produces variations in the counting rate in a detector behind the absorber. The registration of these variations in synchronism with the source movement provides information on the amplitude and phase of the source movement. The synchronous counter here consists of six scalers, and the circuitry which generates the signal driving the source (mechanically or acoustically) and which synchronously fans out the counts into the scalers is described in detail. The computer method of analyzing the results is also described. The special characteristics of the technique, aside from its sensitivity (proportional to frequency) and applicability to small systems, are the possibility of observation at a distance and through intervening objects and its insensitivity to brief gross movements. It is therefore particularly suitable for in vivo measurements on the mechanism of hearing. Applications and comparisons with other techniques are discussed. (auth)

34620 STUDY OF PYRIMIDINE DIMERS IN MAMMALIAN CELLS SURVIVING LOW DOSES OF ULTRAVIOLET RADIATION. Trosko, J. E.; Kasschau, M. R. (Oak Ridge National Lab., Tenn.). Photochem. Photobiol., 6: 215-19(Mar. 1967). (ORNL-P-2170).

Some bacterial strains are resistant to killing by uv radiation because they can excise uv-induced pyrimidine dimers from their DNA. However, pyrimidine dimers are not excised as parts of small trichloroacetic acid-soluble pieces in certain strains of mammalian cells grown in vitro. Studies were carried out to answer the following questions. Does excision occur at low doses where an appreciable fraction of the cells survive? Can excision occur in an oligonucleotide (~5 to 20 nucleotides in length) and hence be undetected? Can excision occur if the cells have a long time to repair the damage? A quasi-diploid Chinese hamster line (CH 46101) was studied in vitro. Thymidine-^{3}H was added to the cultures, and just prior to irradiation, the radioactive medium was replaced with nonradioactive medium containing thymidine. The cells were irradiated with uv light (2650 Å at a dose rate of 1 to 5 erg/mm^2/sec). Results indicated that the thymine-containing pyrimidine dimers were not excised as parts of pieces smaller than 20 nucleotides. When cells were given 400 erg/mm^2 (a dose that allowed less than 0.1% macrocolony formation) three events were observed. The ratios of (TT)/T (thymine dimer/thymine) in the insoluble fractions were not significantly different from each other at three sampling times. The ratio of (TT)/T in the soluble fraction at 24 hr was extremely high. The ratios of total (TT)/T in all fractions were not constant with the sampling time (0 hr = 0.021%; 6 hr = 0.018%; 24 hr = 0.29%). Even though there was a high ratio of dimers to thymine in the soluble fraction of the 24-hr postirradiation cells, it was not the result of an excision-repair mechanism because a concomitant decrease in the (TT)/T ratio was not seen in the 24-hr high molecular wt fraction. It was concluded that uv-induced pyrimidine dimers are not excised from the DNA of Chinese hamster cells in small oligonucleotides. At doses whereby many cells survive irradiation, the dimers were still associated with the large polynucleotides even after 48 hr of postirradiation incubation. (BBB)

34621 TRACER ANALYSIS BY COMPUTER SIMULATION. Siler, William (Downstate Medical Center, Brooklyn). Nat. Cancer Inst. Monogr., No. 24, 65-73(Feb. 1967).

It is demonstrated how mathematical models can be developed and analytical solution can be obtained by computer means to analyze problems involving radioactive tracer distribution. A discussion is also given of models for assessing tumor cell radiosensitivity and destruction in radiotherapy. The technique for investigating such systems by simulation is considered. In this technique, a hypothetical model of the system's workings is constructed; the mathematical equations corresponding to this model are set up; the equations are then solved, and the performance of the simulated system is compared to the actual measurements made upon the real system. The model used may be a precise mathematical or logical description of a system, a device (usually an electronic computer) set up to duplicate in some measure the functioning of the system, or at least a more-or-less vague idea in the mind of the experimenter conducting the research. The computer specialist reduces this model to precise terms, so that he may implement it on his computer and determine its performance. The first step is the drawing of a block diagram of the system; next, the mathematical equations describing the block diagram are set up. A computer program to evaluate the performance of this hypothetical system is then written, and the model's performance determined. Comparison of the model with the performance of the actual system is then made. In most cases an iterative process will occur, with new experiments suggesting modifications of the model which in turn suggest new experiments. It is doubtful that the performance of any biological system will ever be completely determined by simulation techniques; it should be possible to gain more and more insight into the functioning of the system by constructing more and more sophisticated models and conducting more and more sophisticated experiments. (BBB)

34622 AN IMPAIRED $^{57}CoB_{12}$ ABSORPTION AND DECREASE IN NUMBER OF GASTRIC CHIEF CELLS IN VITAMIN B_2 DEFICIENT RATS. Arakawa, Tsuneo; Sato, Mitsuko (Tohoku Univ., Sendai). Tohoku J. Exp. Med., 87: 351-7(Dec. 1965).

Albino rats, weighing 60 to 80 g, were fed a diet deficient in vitamin B_2 and control diet for 3 weeks, and then $^{57}CoB_{12}$ (50 mμc/5 mγ) was administered with a stomach tube. Stools were collected for 10 days and $^{57}CoB_{12}$ was measured. After feeding with control diet and diet deficient in vitamin B_2 for 31 days, histologic examination was made on mucous membrane of the stomach, and the $^{57}CoB_{12}$ binding capacity of gastric mucosa was measured. The average intestinal absorption rates of $^{57}CoB_{12}$ were 66.1% and 36.2% in the control and the vitamin B_2 deficient group, respectively. The $^{57}CoB_{12}$ binding capacity of gastric mucosa was from 55.8 to 61.0% in the control rats, while it was from 40.3 to 50.3% in the vitamin B_2 deficient rats. The incidence of chief cells, mucous neck cells, parietal cells, and columnar cells of surface epithelium (gastric fundus region) were examined and expressed as percent. After the vitamin B_2 deficient diet, a decrease in the number of chief cells, accompanied by an increase of mucous neck cells, was observed. Atrophy of chief cells was also observed, even when the number of chief cells was not much decreased. These histologic findings are highly significant in view of the fact that chief cells are the source of production of gastric intrinsic factor. (NSA of Japan)

34623 THYMUS-MARROW CELL COMBINATION. SYNERGISM IN ANTIBODY PRODUCTION. Claman, Henry N.; Chaperon, Edward A.; Triplett, R. Faser (Univ. of Colorado Medical Center, Denver). Proc. Soc. Exp. Biol. Med., 122: 1167-71 (1966).

Nine- to 12-week-old LAF_1 or CBA/J recipient male mice were exposed to 650 to 750 R doses of x radiation; irradiation was followed by an intravenous injection of syngeneic cells (spleen, thymus, marrow, or thymus plus marrow). To determine the percentage of syngeneic cells that reached recipient spleens, the cells were labeled with ^{3}H-thymidine. When 5×10^6 spleen cells from nonimmunized CBA/J donors were injected into irradiated syngeneic recipients, the mean number of active areas in the spleen after five days was 2.5 times that found when 2×10^6 spleen cells were injected. About 2.2×10^6 cells produced one active area in both cases, and 0.5×10^6 spleen cells from donors injected three days previously with sheep red cells (labeled immune) produced as many active areas as 2×10^6 nonimmune cells. After x-irradiated recipients received injections of antigen on days 1 and 4 they were sacrificed on day 8, some animals were given 10^7 syngenetic marrow cells either alone or together with thymus cells. Spleens of mice receiving 5×10^7 thymus cells plus 10^7 marrow cells had more and strikingly larger zones of lysis than animals receiving either cell type alone. LAF_1/J mice were used in subsequent experiments because of their greater resistance to x rays. When mice received 10^7 marrow cells, the response curve was linear at least through 5×10^7 thymus cells with 5.5×10^6 cells producing one active area and 10% sp act. Thymus cells alone were much less effective and 4.3×10^7 cells were required to produce one active area. In the reciprocal experiment the hemolytic response was evaluated as a function of the number of marrow cells injected. In mice receiving varying numbers of marrow cells plus 2×10^7 thymus cells, the response was linear between 2×10^6 and 2×10^7 marrow cells, but leveled out with higher doses of marrow. Recipients of marrow cells alone were never more active than controls given no cells. It was concluded that the effector cell was marrow-derived, and that the thymus provided the auxiliary cells. (BBB)

34624 THE EFFECT OF A STRONTIUM REPLACEMENT FOR CALCIUM ON CARBOHYDRATES AND OTHER PRODUCTS OF PHOTOSYNTHESIS IN PROTOSIPHON BOTRYOIDES. Denton, Tommy Eugene. University, Ala., Univ. of Alabama, 1966. 62p.

Thesis.

The green alga Protosiphon botryoides Klebs, grown in a medium containing calcium and in a medium containing a strontium-replacement for calcium, was analyzed quantitatively for carbohydrates and other products of photosynthesis. Among the carbohydrates quantitatively analyzed the reducing sugar, sucrose, oligosaccharide, and cellulose fractions were each found to be

present in amounts less than one percent of the total dry weight of algal cells. Starch represented approximately 3% and hemicellulose approximately 6% of the total dry weight. The total carbohydrate fraction represented approximately 10% of the total dry weight of Protosiphon. No large quantitative differences were found between carbohydrate fractions from cells grown in a medium containing calcium, and from cells grown in a medium containing a strontium replacement for calcium. Using chromatographic and autoradiographic methods for analyzing extracts of Protosiphon, nine spots were detectable that were labelled with carbon-14 or carbon-14 and phosphorus-32 after exposure to these isotopes during a 12 hour period of photosynthesis. The compounds identified on the basis of co-chromatography and reagent sprays, from cells grown both in calcium medium and in strontium medium, were sucrose, glucose, fructose, alanine, and glutamic acid. In addition, there were two compounds with reducing power that were tentatively identified as fructose-1-6-diphosphate and fructose-6-phosphate. Two compounds were identified as carboxylic acids and one was ninhydrin-positive and therefore an additional amino acid or related compound. The final spot chromatographed to the expected position of phosphoglyceric acid. Compounds from cells grown in calcium medium and cells grown in strontium medium were qualitatively similar. Quantitatively, there were differences in the compounds in the phosphate ester region of the chromatogram. (auth) (Disser. Abstr.)

34625 STUDIES IN GENETICS. III. MORGAN CENTENNIAL ISSUE. Wheeler, Marshall R. (ed.). The University of Texas Publication Number 6615. Austin, Tex., University of Texas, 1966. 571p.

Separate abstracts were prepared on three papers. Thirteen additional papers discuss the results of other genetic studies on insects. (C.H.)

For abstracts of individual papers see: 34635, 34689, and 34690.

Ecology

34626 (COO-1358-3) THE CYCLING OF ^{36}Cl LABELED DDT IN A MARSH ECOSYSTEM. Meeks, Robert L.; Peterle, Tony J. (Ohio State Univ. Research Foundation, Columbus). Apr. 1967. Contract AT(11-1)-1358. 234p. Dep. CFSTI.

Thesis. Submitted by Robert L. Meeks.

An enclosed four-acre freshwater marsh located along the southwestern edge of Lake Erie was treated with 3.9 mCi ^{36}Cl ring-labeled-DDT at a rate of 0.2 lbs of technical DDT per acre. To determine the accumulation and distribution of DDT rather than its effect, the ^{36}Cl-labeled DDT residues were traced from one hour until 15 mo after the application. Approximately 5000 environmental samples were assayed. Whole-body residues were of major concern; tissue samples were assayed from vertebrates that were too large to assay as a unit. Results showed that DDT was rapidly accumulated in the biotic environment. Residues were detected in bladderwort, carp, crayfish, duckweed, sago pondweed, and tadpoles when they were assayed four hours after the application of DDT. Three days after the application of DDT, Cladophora contained an average of 96 ppm, or 3125 times the environmental level. Fat contained the highest residues in most vertebrate tissues. A water snake accumulated 40 ppm 15 months after the application. The maximum level in carp was 19 ppm in the soft palate; the skin and eyes also contained relatively high residues. Plants and most invertebrates accumulated the highest residues during the first week while DDT could still be detected in the water; longer periods of time were required by vertebrates. Tadpoles were an exception in that they immediately accumulated the highest DDT residues. Examples of food-chain residue accumulation are noted. Plants reaccumulated low residues when they commenced growing the second year. The DDT residues in invertebrates, plants, and small vertebrates remained fairly low throughout the second year; higher quantities often occurred in tissues from large vertebrates. It was concluded that algae, carp, crayfish, duckweed, and pondweeds (Potamogeton sp.) were good indicators of environmental levels of DDT. (B.H.S.)

34627 (UH-235P4-2) IMPROVEMENT AND APPLICATION OF BENTHIC ALGAL ISOTOPE PRODUCTIVITY MEASURING METHODS. Annual Report. Hawaii Botanical Science Paper No. 3. Doty, Maxwell S. (Hawaii Univ., Honolulu). 1967. Contract AT(04-3)-235. 441p. Dep. CFSTI.

Progress is reported on studies on the productive ecology of benthic algae on Hawaiian reefs. Analytic methods were developed for use in ^{14}C measurements of open-ocean food production rates and organic productivity of phytoplankton. Methodology and procedures used for data analysis are discussed. A list is included of 13 papers published during the period covered by this report. (68 references.) (C.H.)

34628 RANGE OF KANGAROO RATS IN AREAS AFFECTED BY ATOMIC DETONATIONS. White, Leland D.; Allred, Dorald M. (Brigham Young Univ., Provo, Utah). Contract AT(11-1)-786. Utah Acad. Sci., Proc., 38: 101-10(1961).

An ecological study at the nuclear test site in Nye County, Nevada, was conducted to compare the habits, kinds, migrations, populations, ranges, and seasonal activities of native animals in natural areas exposed to atomic detonations with animals in contiguous nonexposed areas. To study animal movements in these areas, two species of kangaroo rats were selected. Since the kangaroo rats are burrowing animals, it was assumed that within a near radius of ground zero, animals that were above ground were killed by direct thermal and high radiation effects of the blast, whereas animals that were underground suffocated from a collapse of their burrows. Totals of 388 Dipodomys merriami and 522 D. microps were marked, released, and recaught 628 and 1017 times, respectively. Animals living in areas disturbed by atomic detonations ranged almost three times as far as animals living in undisturbed areas. There was little difference between the distances animals moved in different plant communities that were undisturbed. There were significant differences between the average ranges of the two species of kangaroo rats in different undisturbed plant communities. There were differences in the distances traveled by different sexes in both species of rats. However, the differences were not consistent, for in some areas males traveled farther than females, whereas the reverse was true in other areas. Most of the animals of each species ranged between 75 and 300 ft. The greatest distance recorded for D. merriami was 10,296 ft, and for D. microps, 5280 ft. Ranges of D. merriami varied from 0.90 to 6.53 acres, and those of D. microps, from 0.69 to 7.80 acres. (BBB)

34629 PROMPT TRANSFER OF ^{137}Cs TO THE SOILS OF A TAGGED LIRIODENDRON FOREST. Waller, H. D.; Olson, J. S. (Oak Ridge National Lab., Tenn.). Ecology, 48: 15-25(Winter 1967). (ORNL-P-2157).

An inventory of total ^{137}Cs distribution in a 500-m^2 tagged tulip poplar (Liriodendron tulipifera) forest at the Oak Ridge National Lab showed transfer from trees to soil during the first growing season. About one-third of the maximum amount of ^{137}Cs found in the tree canopy during June was transferred to the forest floor and soil; the remainder moved back into woody tissue (stem and roots) before leaf fall. Losses of radiocesium from the foliage and stems into the plot area through litterfall (55 $\mu Ci/m^2$) and rain leaching (13 $\mu Ci/m^2$) accounted for almost 8% (68 $\mu Ci/m^2$) of total ^{137}Cs (934 $\mu Ci/m^2$) introduced into tree boles. However, soil (including roots) and litter sampling at the end of the growing season indicated a much larger quantity (414 $\mu Ci/m^2$ or 45% of initial input) already in the surface 30-cm layer of mineral soil. Of the total ^{137}Cs activity found within the mineral soil layer, about half could be physically associated with the tagged trees through removal of roots from soil samples and cumulative measurement of surface income at time of soil collection. Much of the remainder was accounted for by contact exchange, root exudation, root death, and leaching of roots by soil solution. (auth)

Genetics and Cytogenetics

Refer also to abstracts 34826 and 34829.

34630 (NYO-1371-52) GENETIC TRANSFORMATION IN HEMOPHILUS INFLUENZAE. Annual Progress Report, September 15, 1966–September 14, 1967. Herriott, Roger M. (Johns Hopkins Univ., Baltimore, Md. Dept. of Biochemistry). Contract AT(30-1)-1371. 14p. Dep. CFSTI.

Progress is reported on studies on genetic transformation in Hemophilus influenzae, in which 3H-thymidine was used as a tracer. Data are included from studies on the effects of various nucleosides and nucleotides in the media on the uptake of thymidine and the fate of host DNA during transformation. The efficiency of joint transformation by DNA carrying two genetic markers was calculated. (C.H.)

34631 (NYO-2043-150) TABLE OF REDUCED GENE TRANSMISSION AND GENOTYPIC AND PHENOTYPIC RATIO. Moh, Carl C. (Inter-American Inst. of Agricultural Sciences, Turrialba (Costa Rica)). 1967. Contract AT(30-1)-2043. 56p. Dep. CFSTI.

Results are reported from genetic studies on radioinduced mutations in barley. The data indicate a deficit of mutants segregated by the heterozygotes. It is postulated that reduced transmission of the mutant genes through gametes is involved. A numerical table is presented for use in calculating genotypic and phenotypic ratios resulting from the transmission of normal and mutant genes through male and female gametes. (C.H.)

34632 (ORNL-P-3066) USE OF SEX-CHROMOSOME ANOMALIES FOR MEASURING RADIATION EFFECTS IN DIFFERENT GERM-CELL STAGES OF THE MOUSE. Russell, Liane Brauch (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 19p. (CONF-670525-2). Dep. CFSTI.

From IAEA Meeting on the Effects of Ionizing Radiation on Meiotic Systems, Vienna, Austria.

The occurrence of sex-chromosome anomalies was used as indices in the measurement of radiation effects on different stages of germ-cells in mice. Several types of anomaly that would be lethal if they involved autosomes could be recovered in viable offspring if the affected chromosomes were the X and/or Y. Marker systems were developed for recognizing a high percentage of the possible anomalous types that resulted from deficiency, monosomy, nondisjunction, and perhaps certain rearrangements. Satisfactory evidence was not obtained for x-ray induction of nondisjunction. On the other hand, the XO phenotype was easily produced. A great majority of the cases was the result of simple monosomy, but a few XO animals that probably carried sex-chromosome deficiencies or aberrations were also observed. By far, the highest yields of sex-chromosome losses were obtained by irradiation of zygotes from the time of sperm entry (second meiotic division) through the early pronuclear stage; during the first part of the period, X^M was considered to be relatively more sensitive than X^P or Y. There was a sharp drop in sensitivity between early and late pronuclear stages. Among gonadal germ cells tested, the ones yielding the highest XO frequencies were the dictyate in mature follicles of the female and the spermatid in the male. Leptotene-through-diplotene oocytes and spermacytes (taken as a group) gave a lower and roughly equal yield. Among spermatocytes, postpachytene stages gave the lowest frequency of XO. (B.H.S.)

34633 (UCRL-70413) THE CHROMOSOME-SCANNING PROGRAM AT LAWRENCE RADIATION LABORATORY. Stone, Stuart P.; Littlepage, James L. (California Univ., Livermore. Lawrence Radiation Lab.). June 12, 1967. Contract W-7405-eng-48. 9p. (CONF-670627-1). Dep. CFSTI.

From Meeting of the Society of Photo-Optical Instrumentation, Washington, D. C.

An automatic chromosome scanning procedure is described that employs a computer-controlled flying spot reader for transparencies obtained with a 35-mm camera attachment to a light microscope. A set of computer programs, CHROMO, was developed for processing scan data. Tests of the procedure for chromosome pattern recognition in 100 metaphase spreads from normal material and 100 spreads from the HeLa cell line showed that a moderately large amount of data can be processed in a production line operation. (C.H.)

34634 GENETIC EFFECTS OF RADIATIONS IN MAN. Freire-Maia, Newton (Univ., Parana, Brazil). Rev. Biol. (Lisbon), 4: 61-86(1963). (In Portuguese).

Genetic effects of ionizing radiation in man are reviewed. Experimental studies in plants and animals, methods of study of human radiogenetics, results of surveys of offspring of patients exposed to radiotherapy and of persons exposed to nuclear weapon detonations, genetic sequelae in children of occupationally exposed persons, frequency of congenital malformations in populations exposed to high levels of natural radioactivity, radiogenetic studies in tissue cultures, and nature of the chromosome aberrations in irradiated individuals are considered. Problems of assessing gonadal and genetic doses of radiation are tabulated. Preventative measures are outlined, and the long-term genetic consequences of low-level exposure of human populations to ionizing radiations are evaluated. Emphasis is given to earlier studies on the possible genetic significance of exposure of Brazilian populations to high and low levels of environmental radioactivity. This includes statistical studies of pre- and postnatal mortality and congenital malformations in coastal regions of Brazil where monazite sands raise the population exposure. (BBB)

34635 MODIFICATION OF INDUCED GENETIC DAMAGE IN DROSOPHILA MELANOGASTER BY OXYGEN AND ARGON TREATMENTS BETWEEN TWO DOSES OF X-RAYS. Elequin, Flora T. pp 177-93 of Studies in Genetics, III. Wheeler, Marshall R. (ed.). Austin, Tex., University of Texas, 1966.

Drosophila melanogaster males were x-rayed with 2 equal doses of either 500 or 1500 R separated by 20 min. They were irradiated in either O_2 or Ar at 1 atm. During the 20 min intervals flies were kept in O_2 or Ar. They were pretreated in the gases for 10 min and post-treated for 20 min. Each male was mated within an hr after treatment and remated every 2 days for 7 consecutive matings. The offspring carried chromosomes irradiated at different stages of spermatogenesis. Chromosome damage was measured by tests for sex-linked recessive lethals, dominant lethals, and translocations. When irradiated in O_2 the damage was greater in the spermatid stage if the flies were in Ar rather than O_2 in the interval between irradiations. When irradiated in Ar no significant difference was found in the degree of damage if the flies were in Ar or O_2 during the interval when the test was for sex-linked recessive lethals or translocations. The dominant lethal tests gave different results which are discussed. In O_2 radiosensitivity was at a peak during the spermatid and meiotic stages. In Ar a differential response was less obvious. The Y-chromosome was involved in less than half the total translocations and showed no autosome preference. Chromosomes 2 and 3 were about equally affected by irradiation. (TSS)

34636 MUTATION IN COLLETOTRICHUM FALCATUM, THE CAUSAL ORGANISM OF RED ROT OF SUGARCANE. VI. INDUCED BIOCHEMICAL MUTANTS AS TEST ORGANISMS FOR BIOASSAY OF P-AMINOBENZOIC ACID AND BIOTIN. Bajaj, B. S.; Chatrath, M. S.; Vasudeva, R. S. (Indian Agricultural Research Inst., New Delhi). Indian Phytopathol., 18: 253-6 (1965).

Biochemical mutants were isolated from Colletotrichum falcatum, the causal organism of sugarcane red rot, after irradiation with ^{32}P added to the medium during the growth phase. The possibility of using these mutants for vitamin bioassay was investigated. A mutant deficient in PABA synthesis and one deficient in biotin synthesis showed a linear growth response to graded concentrations of PABA ranging from 2×10^{-4} to 4×10^{-3} $\mu g/ml$ and biotin ranging from 1×10^{-4} to 8×10^{-4} $\mu g/ml$. The mutants did not show any tendency to revert after 4 to 5 years and their dependency on the vitamins was absolute, thus fulfilling the qualifications for use in biosasays. (M.M.B.)

34637 MUTATION IN COLLETOTRICHUM FALCATUM, THE CAUSAL ORGANISM OF RED ROT OF SUGARCANE. V. PATHOGENICITY OF BIOCHEMICAL MUTANTS. Bajaj, B. S.; Chatrath, M. S.; Vasudeva, R. S. (Indian Agricultural Research Inst., New Delhi). Indian Phytopathol., 18: 133-8(1965).

Mutants of the red rot fungus, Colletotrichum falcatum, of sugarcane were subjected to ^{32}P during the growth phase. Twelve induced mutants showing specific vitamin deficiencies were isolated and tested for pathogenicity. The loss of a synthetic ability did not always result in reduced virulence, nor did mutants exhibiting similar deficiencies show the same trend in pathogenicity. A mutant deficient in the ability to synthesize p-aminobenzoic acid was avirulent, but when the vitamin was incorporated into the sugarcane host system partial restoration of pathogenicity resulted. (M.M.B.)

34638 MUTATION IN COLLETOTRICHUM FALCATUM WENT, THE CAUSAL ORGANISM OF RED ROT OF SUGARCANE. I. INDUCED BY BETA RADIATION. Vasudeva, R. S.; Iyengar, M. R. S.; Bajaj, B. S.; Chatrath, M. S. (Indian Agricultural Research Inst., New Delhi). Indian Phytopathol., 11: 91-5(1958).

A stable mutant of Colletotrichum falcatum Went has been obtained with the help of radioactive phosphorus when the fungus was grown on liquid medium containing ^{32}P with an initial activity level of about $240 \mu c/ml$. The mutant resembles the well-known dark type of C. falcatum with lesser sporulation. The spores of the mutant are characteristically smaller in size and vary in shape as compared to the normal falcate shape. (auth)

34639 GROWTH PHASE METHOD FOR MUTANT-SCREENING IN COLLETOTRICHUM FALCATUM WENT. Bajaj, B. S.; Chatrath, M. S. (Indian Agricultural Research Inst., New Delhi). Indian Phytopathol., 13: 156-60(1960).

A method of irradiation of growing cultures of C. falcatum by incorporating ^{32}P in the medium or with an external source of radiation, and screening of morphological, as well as biochemical, mutants is described. It is brought out that the method not only enhances mutation efficiency but also magnifies its expression and thus facilitates screening. (auth)

34640 MUTATION IN COLLETOTRICHUM FALCATUM WENT, THE CAUSAL ORGANISM OF RED ROT OF SUGARCANE. II. INDUCED BY FAST NEUTRONS. Bajaj, B. S.; Ganju, P. L.; Chatrath, M. S. (Indian Agricultural Research Inst., New Delhi). Indian Phytopathol., 12: 53-8(1959).

A mutant was isolated from Colletotrichum falcatum spores which had been irradiated with fast neutrons (0.35×10^7 n/cm^2/sec) for 2 hr. The mutant differed from the wild type in the loss of pink spore pigmentation and a lowered conidia germination percentage; however, full virulence was retained. (M.M.B.)

34641 STUDIES ON THE MUTATION BREEDING IN JAPAN. Yamaguchi, Hikoyuki (Tokyo Univ.). Radioisotopes (Tokyo), 15: 241-53(Sept. 1966). (In Japanese).

Applications of radiation in plant breeding programs in Japan are reviewed. The production of new varieties of barley, rice, and soybeans is reported. (TSS)

34642 THE INFLUENCE OF ATP AND DNP ON CHROMOSOME DAMAGE IN BARLEY GERM CELLS AFTER γ-IRRADIATION AND THE ACTION OF FAST NEUTRONS. Valeva, S. A. (Inst. of General Genetics, Moscow). Radiobiologiya, 7: 285-8 (1967). (In Russian).

Barley seeds containing about 10% moisture were subjected to a 10 kR dose of γ-radiation and a 200 rad dose of fast neutrons and then steeped for 24 hours in solutions of ATP (2×10^{-3} moles per liter) and DNP (3×10^{-4} moles per liter). The results are presented graphically and show that DNP increased and that ATP reduced the number of damaged chromosomes after γ-irradiation but did not change the effect of fast neutrons. (JPRS)

34643 MUTATIONAL RECTIFICATION OF SPECIFIC DEFECTS IN SOME POTATO VARIETIES. Jauhar, Prem P.; Swaminathan, M. S. (Indian Agricultural Research Inst., New Delhi). Curr. Sci. (India), 36: 340-2(July 5, 1967).

Mutations were studied in two commercially important Indian varieties of potatoes following external exposure of tubers to ^{60}Co γ rays (6 and 10 kR) alone or in combination with uv or internal exposure from implants of ^{32}P, ^{35}S, and ^{45}Ca. A variety of somatic mutations was observed including changes in shape and texture of leaves, and in shape, color, and texture of tubers. The nature of the genetic change responsible for the somatic mutations was not identified. (H.G.D.)

34644 TERATOGENIC ACTION OF X RAYS ON THE RAT EMBRYO. I. DOES THE MATERNAL OVARY INTERVENE. Marois, Maurice (Faculte de Medecine, Paris). Bull. Acad. Nat. Med. (Paris), 150: 179-85(Mar. 22, 1966). (In French).

The incidence of developmental anomalies in rats irradiated on the 10th day of gestation was studied. The pregnant rats received x ray doses of 100, 125, 150, 200, or 300 R at a dose rate of 20 R/min. Some rats were ovariectomized 2 hr after injections of progesterone (20 mg/ml). To maintain pregnancy the ovariectomized rats received subsequent injections of progesterone and estradiol. In the intact rats the rate of abnormal fetuses was 25.4% after 100 R, 48% after 125 R, 40.4% after 150 R, and 15% (+46% resorbed fetuses) after 200 R. Anencephaly and exencephaly were the principal anomalies observed. In the ovariectomized rats a similar rate of anomalies and dead fetuses was noted. The results showed that the presence or absence of the ovary does not influence the teratogenic action of x irradiation on the developing central nervous system. (BBB)

34645 EFFECTS OF ALPHA IRRADIATION PRODUCED BY THERMAL NEUTRON REACTION WITH BORON ON BARLEY SEEDS. Blancaver, Arturo T. (Univ. of the Philippines, Laguna); Ehrenberg, Lars. Philippine Agr., 49: 138-45(July 1965).

Dormant seeds of barley (Hordeum vulgare) with 12% moisture content were soaked for 4 hr in 0, 0.2, and 0.8M concentrations of B using boric acid as the source of B. The B-treated seeds were then air-dried and irradiated with various thermal-neutron doses, given in Kw-sec, 1 Kw-sec being equivalent to 1.1×10^9 thermal neutrons/cm^2. Seed soaked in water only and irradiated at doses as high as 1200 Kw-sec gave a germination percentage of about 75% and showed that the neutrons alone had very little effect on germination. When the materials were soaked in 0.2M boron and given the same neutron dose of 1200 Kw-sec, germination decreased to about 41%. Seeds treated with 0.2M boron showed a gradual decrease in germination as neutron doses were increased. When the concentration of B was increased to 0.8M, there was an abrupt decrease in the percentage of germination (48% at 0 Kw-sec to 25% at 450 Kw-sec). Neutrons alone, even at doses as high as 1200 Kw-sec, produced very little effect on plant height, survival of plants, and chlorophyll mutations. Treatments with 0.2M B gave more chlorophyll mutations in the X_2 generation than with 0.8M B treatments. Most of the chlorophyll mutations observed were of the albina and viridis types and appeared in almost the same frequency. (BBB)

Health Physics and Safety

Refer also to abstracts 34562, 34585, 34701, 34742, and 34751.

34646 (AECL-2900) PURPOSES, INTERPRETATION, AND REQUIRED ACCURACY IN RADIATION MONITORING OF THE WORKING ENVIRONMENT. Cowper, G. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1967. 10p. (CONF-670621-1). Dep. CFSTI. CAN $0.50.

From Symposium on Radiation Dose Measurements, Their Purpose, Interpretation, and Required Accuracy in Radiological Protection, Stockholm, Sweden.

The purposes, interpretation, and accuracy required in the radiation monitoring of the working environment must continue, as always, to be based upon the best understanding of the adverse effects of ionizing radiation upon man. The consensus of the best available expert opinion has led to the recommendations of the International Commission for Radiological Protection and in the matter of formulating controls and carrying out practices for the monitoring of the working environment, the fact that our endeavours stem from these recommendations must always be kept in mind. It is the purpose of this review to examine just how well we are succeeding in meeting our objectives. Are we uniformly cautious or careless in our methods, or have we succumbed to the temptation of improving those techniques which are easy to improve while abandoning the more difficult problems? To what extent have we demanded an accuracy in monitoring which is inconsistent with the extent of our knowledge of radiation effects. How much are we, as health physicists, because of our practices, responsible for a state of over-concern for radiation safety which is hardly consistent with the established record of safety in those industries and enterprises using ionizing radiation and radioactive substances? Our purpose in radiation monitoring is to assist the users of radiation to have the highest productivity and safe, satisfactory working conditions. The accuracy of our measurements and the interpretations we draw from them must be designed to accomplish this purpose. (auth)

34647 (AEET-273) GAMMA ACTIVITY OF THE FOOD SAMPLES IN INDIA DURING THE PERIOD 1963-65. Deshpande, A. S.; Vohra, K. G. (Atomic Energy Establishment, Trombay (India)). 1966. 19p. Dep.

Data are presented on the γ radioactivity due to fallout in leafy vegetables, root vegetables, cereals, grass, foodstuffs, and composite meals sampled in India from 1963 to 1965. The fission products considered were ^{144}Ce, ^{137}Cs, ^{106}Ru, ^{125}Sb, and ^{95}Zr + ^{95}Nb. The contents of the induced isotope ^{54}Mn and naturally occurring ^{40}K were also measured. (C.H.)

34648 (BARC-278) ^{137}Cs AND POTASSIUM IN MILK. Mishra, U. C.; Deshpande, A. S.; Varma, R. Kerala; Kamath, Kum. P. G. (Bhabha Atomic Research Centre, Bombay (India)). 1967. 21p. Dep.

Data are presented on the content of ^{137}Cs and K in milk samples collected in India from 1960 to 1967. The highest content of ^{137}Cs was found during 1963. No effects of rainfall or latitude on the ^{137}Cs content in milk were observed. (C.H.)

34649 (BNWL-316(App.)) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD FOR 1965. Appendices. Moore, Darlene; Essig, T. H. (eds. and comps.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1966. Contract AT(45-1)-1830. 146p. Dep. CFSTI.

Results obtained from both radiochemical analyses of environmental samples and from radiological measurements made in the Hanford area during 1965 are presented in tabular form. Environmental samples consisted of air, commercial foodstuffs, farm produce, fish, marine organisms, waterfowl, and water samples from various areas of the Columbia River. (B.H.S.)

34650 (BNWL-322) PACIFIC NORTHWEST LABORATORY MONTHLY ACTIVITIES REPORT, AUGUST 1966, ON AEC DIVISION OF BIOLOGY AND MEDICINE PROGRAMS. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Sept. 1966. Contract AT(45-1)-1830. 18p. Dep. mn. CFSTI $3.00 cy, $0.65 mn.

Brief summaries are presented of work in progress in the areas of: atmospheric radioactivity and fallout including atmospheric tracers, atmospheric transport and diffusion of fallout, fallout rate and mechanisms, precipitation scavenging studies, and radioisotopes as particles and volatiles; environmental radiation studies including earth sciences, ecology of Columbia River, radioisotope in Alaskan Eskimos, and terrestrial ecology of Hanford Reservation; marine sciences including physical chemistry of ocean solutions; neutron activation analysis of content of ^{75}Sc in plants; radiation biology including cellular regulatory mechanisms, characterization of radioinduced free radical reactions in aqueous systems, mechanisms and treatment of gastrointestinal radiation effects, response of insects to radiation, and toxicity of radioisotopes; radiation detectors and dosimeters; and radiological and health physics including film dosimetry calibration studies, radiation dosimetry, and radiation physics. (B.H.S.)

34651 (BNWL-SA-1105) INHALATION AND RETENTION OF ^{239}Pu MICROSPHERES IN BEAGLE DOGS. Willard, Donald H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 14, 1967. Contract AT(45-1)-1830. 10p. (CONF-670610-4). Dep. CFSTI.

From 12th Annual Meeting of the Health Physics Society, Washington, D. C.

To determine whether 50μ $^{239}PuO_2$ particles could be inhaled and deposited in the respiratory tract, how long large ^{239}Pu par-

ticles would be retained if deposited in the lungs, and the biological effects that might develop from the retention, beagle dogs were exposed to air in which 50μ $^{238}PuO_2$ particles were dispersed or were implanted with 50 to 300μ particles in the lungs by intubation Whole-body longitudinal scanning techniques were used to follow the course of the particles in the dogs. When the 50μ air-dispersed particles were inhaled by the dogs, the particles were deposited in the nasal pharynx region and excreted in the feces over a period of a few days. Apparently, no particles were deposited in the lower respiratory tract, or if they were, clearance was rapid and complete. When 50 to 300μ $^{238}PuO_2$ particles were deposited in the lungs by intubation, the lungs were cleared within 10 days. Nine dogs retained particles for several months, and two dogs retained particles for a year. No effects were observed except for a possible lymphopenia in one dog that retained a 300μ particle for over a year. (B.H.S.)

34652 (DCROF-(2)-79) REPORT ON A SYMPOSIUM ON THE RADIOLOGICAL PROTECTION OF THE WORKER BY THE DESIGN AND CONTROL OF HIS ENVIRONMENT HELD AT BOURNEMOUTH, APRIL 1966. Donegan, D. P. (Royal Ordnance Factory, Chorley (England)). 23p. Dep.

Brief summaries are presented of 62 papers that discuss various aspects of the radiation protection of personnel working with radioactive substances and sources of ionizing radiations. (C.H.)

34653 (DP-1098) RADOS: A CODE TO ESTIMATE GAMMA DOSE FROM A CLOUD OF RADIOACTIVE GASES. Cooper, Roger E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). June 1967. Contract AT(07-2)-1. 23p. Dep. CFSTI.

RADOS is a computer code that represents the finite spatial distribution of airborne source material as an infinite number of line sources. The code provides a means of rapidly calculating whole body gamma dose from a finite cloud of radioactive material. The simplifying assumptions used to minimize computation time are: (1) The material release is instantaneous and results in a radioactive cloud of unit thickness in the X or downwind direction. (2) There is no change in the size and shape of the cloud during passage over the effective range of the receptor. (3) The gamma buildup factors can be expressed analytically with sufficient accuracy. These assumptions limit the applicability of RADOS as follows: the material release should occur over a relatively short time; the receptor distance should be more than 600 meters downwind from the release point; and the gamma energies should be in the specified range. A 4-group, 12-isotope, 1-receptor-point problem requires approximately 1.75 seconds on the IBM System/360-65. (auth)

34654 (NP-16517) SRAVNITEL'NYI ANALIZ GLOBAL'NYKH VYPADENII PRODUKTOV YADERNYKH VZRYVOV NA MATERIKI I OKEANY. (Comparative Analysis of Global Fallout of Nuclear Explosion Products in the Oceans and Continents). Karol, I. L.; Krasnopevtsev, Yu. V.; Vilenskii, V. D.; Malakhov, S. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow). 1965. 24p. (In Russian). Dep.

A comparative analysis was made of global fallout from September, 1959, to August, 1961; data from Russian and American measurements on the continents and in the Atlantic and Pacific Oceans were used. The content of fallout and the concentration of ^{90}Sr in air just above the surface were evaluated separately for continents and oceans; data were compared. The mean square deviations of the values were calculated; the scatter during measurement was taken into account. The results are tabulated and graphed. (J.S.R.)

34655 (NUS-229(Rev.)) DOSE CALCULATION MODELS FOR RE-ENTERING NUCLEAR ROCKET DEBRIS. DeAgazio, Albert W. (NUS Corp., Washington, D. C. Environmental Safeguards Div.). May 12, 1965. Revised Jan. 1967. Contract SNPC-6. 51p. Dep. CFSTI.

Estimation of the biological hazards resulting from nuclear rocket engine flight failures is complicated by the more or less random nature of the deposition of engine debris into the biosphere. The debris may come to earth in an uninhabited desert or in the midst of a large city. In the first case, the probability of direct exposure of individuals to the debris will be vanishingly small, whereas in the latter case the probability may be extremely high. Similarly, the probability of indirect exposure through ingestion is directly related to the likelihood of the debris falling on cultivated land. The probabilistic approach to the evaluation of dose was initially treated in an earlier report, NUS-167, and much of this report is a refinement of that work. The external dose functions and external and internal dose probability functions are derived in this report. External whole body gamma and beta dose relationships are derived for receptors who are mobile; i.e., who are not fixed in a given location for the entire exposure period. The probability of receiving at least a given external dose, the fraction of the population receiving at least a given dose and the overall population dose are also derived for external gamma radiation exposures. The functions for determining the probability of a receptor being struck by a particle that sticks to the skin and the number of people so affected are derived to allow estimation of the hazard from localized beta doses to the skin. Internal dose probability functions are derived for both ingestion and inhalation. These relations consider cultural influences such as diet, agricultural production, and population density. Functions for estimating critical organ doses resulting from plant uptake and subsequent ingestion are not derived in this report because of the variations in soil characteristics, dietary intake and cooking and eating habits that exist throughout the world. Comparisons are made, however, to fallout from nuclear weapon testing and subsequent appearance of ^{90}Sr and ^{137}Cs in food in the United States. (W.E.B.)

34656 (ORNL-P-3160) RADIOSTRONTIUM UPTAKE IN BLOOD AND FLESH IN BLUEGILLS (LEPOMIS MACROCHIRUS). Reed, J. R.; Nelson, D. J. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 17p. (CONF-670503-17). Dep. CFSTI.

From 2nd National Symposium on Radioecology, Ann Arbor, Mich.

The rapid uptake of ^{90}Sr by bluegills (Lepomis macrochirus) was attributed to a quickly exchanged Sr pool in flesh and blood. Two percent of the Sr pool in blood consisted of a component having a biological half-life of 2 hours. Another 1% of the blood Sr exchanged in 35 days and 97% was contained in a component with a long, undetermined biological half-life. Strontium in blood contributed less than .0009% to the Sr in flesh. At least three compartments of Sr metabolism were identified in flesh. One percent of the Sr in flesh was turned over with a biological half-life of about 2 hours while 9% was turned over with a half-life of 9 days. The remaining 90% of Sr in flesh had a long but undetermined half-life. Uptake of Sr in the quickly exchanged Sr pool was directly proportional to the Sr concentration in test solutions in the range from 0.3 to 300 ppb Sr. At 3000 and 30,000 ppb Sr, bluegills took up more Sr than at the lower concentrations indicating an inability to discriminate against Sr at abnormally high environmental concentrations. (auth)

34657 (STI-PUB-135) RADIOISOTOPES AND RADIATION IN DAIRY SCIENCE AND TECHNOLOGY. Proceedings Series. Proceedings of a Seminar held in Vienna, 12–15 July 1966. (International Atomic Energy Agency, Vienna (Austria)). Nov. 1966. 268p. (CONF-660711). IAEA: $6.00; S 155,-; £2.2.4; F Fr 29,40; DM 24,-.

Separate abstracts were prepared on six papers. Nine papers were abstracted previously and appeared in NSA as CONF-660711, papers 1, 2, 3, 4, 5, 6, 7, 8, and 9. (C.H.)

For abstracts of individual papers see: 34410, 34411, 34667–34669, and 34849.

34658 (USNRDL-TR-67-39) FEASIBILITY AND POTENTIAL EFFECTIVENESS OF PARTIAL-BODY SHIELDING FOR PERSONNEL PROTECTION AGAINST IONIZING RADIATION. Shapiro, E. S. (Naval Radiological Defense Lab., San Francisco, Calif.). Apr. 11, 1967. 61p.

The feasibility of partial-body shielding is discussed from two points of view. The first assumes that limited clinical and experimental data are extrapolable to the operational situations of interest and that it is possible to selectively protect against the neural, hemapoietic, and gastrointestinal components of the acute radiation syndrome. Under this assumption, it would appear that neural syndrome symptomatology may be adequately controlled by means of drugs; the hemapoietic syndrome may be controlled by a lightweight (under 10 lbs) lead epicondylar cuff; and in many operational situations the gastrointestinal syndrome may be controlled by an abdominal shield sufficiently light in weight to permit postattack personnel to efficiently perform their tasks. The second point of view discussed assumes that, at present, there is not an adequate basis for selective syndrome shielding, and that a metal shield covering all of the body from the hips to the neck is the only adequate form of protection. Under this assumption, weight limitations preclude the use of this type of shield in most situations in which personnel must enter the fallout field at specified times and remain until the completion of their mission. However, in the case of personnel who are not required to enter the field at any specified time and who may be recalled after receiving a predetermined dose, trunk shields of acceptable weights would significantly lower entry times and extend stay times. The use of a grid (sieve) trunk shield is discussed and it appears that a shield of this type, of acceptable weight, may be of benefit in many operational situations in which the solid shield was not. Drug protection in conjunction with both

solid and grid shields is evaluated; it was concluded that a marked reduction in the weight requirements of effective shields of both types could result from such a combination. (auth)

34659 (ORNL-tr-1693) CIVIL DEFENSE IN RURAL REGIONS. A TEXTBOOK. Translation of Grazhdanskaya Oborona v Sfl'skikh Raionakh. Uchebnoe Posobie, Military Publishing House of the USSR Ministry of Defense, Moscow, 1965. 196p. Dep. CFSTI. JCL $13.50 fs, $6.08 mf.

Civilian defense procedures for commanding and headquarters civil defense personnel of collective and state farms and of other institutions in rural regions of the Soviet Union are presented. The following topics are discussed: methods of attack; design of atomic and thermonuclear weapons; shock wave effects; thermal radiation; immediate gamma and neutron radiation, fallout contamination; radiation sickness; biological weapons; chemical weapons; protection of animals and crops; personnel and staff training; protection of the population; gas masks; protective clothing; fallout shelters; rescue work; and radiation detectors. (W.E.B.)

34660 DANGERS OF X RAYS AND PROTECTION OF THE PRACTITIONER AND PATIENT IN DENTISTRY. Bollaert, A. (Univ., Brussels). Rev. Belg Med. Dent., 20: 121-36(1965). (In French).

The somatic and genetic effects of ionizing radiations are reviewed preliminary to a discussion of the prevention of overexposure to x rays of patients and personnel in dental radiography. By use of the most sensitive films available, the dose can be reduced as much as 60%. The irradiated field should be reduced to no more than 6 cm in diameter. The direction of the x-ray beam should be such that only the dental field is within the beam. It is estimated that a dental radiograph that gives a dose of 0.5 to 2.7 R to the skin results in a gonad dose of ~0.5 mR, whereas a complete series may give a gonad dose of 4 to 6 mR. Children and pregnant women require special consideration in dental radiography. Soft radiation that is of no use to the radiograph yet increases the skin dose should be reduced with appropriate filtration, such as 2 mm of Al. Reduction of exposure to the dentist and his assistants can be accomplished by not holding the film during exposure, eliminating stray radiation, and keeping at a proper distance from the x-ray tube during operation. Film-badge dosimeters should be worn. (BBB)

34661 UPTAKE AND EXCRETION OF RADIOACTIVE SUBSTANCES BY DAIRY COWS: EFFECTS OF RADIOACTIVE FALLOUT ON CATTLE AND PROTECTIVE MEASURES. Hill, H. (Tierarztliche Hochschule, Hanover). Arch. Lebensmittelhyg., 17: 49-54(Mar. 1966). (In German).

The uptake of ^{131}I, ^{89}Sr, ^{90}Sr, and ^{137}Cs by cattle was studied. Following daily oral administration of ^{131}I, concentration in milk of cows amounted to ~0.8%, or more, of the dose administered. In lactating goats 15 to 25% of oral ^{131}I appeared in milk within 17 days, and ~70% was excreted. Up to 10% of a daily dose of ^{131}I given orally with NaI appeared in the milk. When Ca was given, excretion of ^{45}Ca and ^{89}Sr increased by ~50%, and the quantities that are found in milk decreased by one half or more. When ^{137}Cs was given to goats or cows daily, 1 to 10% was found in the milk. In sheep given from 0.25 to 0.32% Na or K in their diet, excretion of ^{42}K or ^{134}Cs was increased 2- or 3-fold. Estimates of the amounts of ^{131}I, ^{90}Sr, and ^{137}Cs that may be injurious or fatal to sheep fetuses indicated that daily uptakes of 0.002, 0.015, and 0.020 mCi/Kg body wt, or single uptakes of 0.1, 1.0, and 0.2 mCi/Kg body wt, respectively, were sufficient when given orally. (BBB)

34662 GUIDELINES FOR RADIATION PROTECTION DURING X-RAY PHOTOGRAPHY. Jung, Till (Univ., Bonn). DDZ (Das Deut. Zahnaerztebl.), 20: 620-6(Oct. 8, 1966). (In German).

Practical methods for radiation protection of dental patients by means of Al shields and close control of the skin field diameter by proper positioning of films are outlined. The effect of skin field diameter on the skin surface dose as a function of the number of dental x rays made is illustrated. A method of protecting the gonads from direct exposure to irradiation during radiography of the mandible by ventral flexion of the head to produce inclination of the plane of occlusion is demonstrated. Effects of scattered radiation and protection of the gonadal areas by a protective shield or Pb glove is illustrated. Protection of the dentist and dental technicians during operation of x-ray equipment by proper positioning is described and illustrated. Examples of improper, satisfactory, and best arrangements of treatment areas and x-ray equipment are shown. (BBB)

34663 NUTRITIONAL EVALUATION OF MILK PROCESSED FOR REMOVAL OF CATIONIC RADIONUCLIDES. FEEDING STUDIES. Isaacks, R. E. (Veterans Administration Hospital, Coral Gables, Fla.); Hazzard, D. G.; Barth, Julius; Walker, J. P.; Fooks, J. H.; Edmondson, L. F. J. Agr. Food Chem., 15: 300-4 (Mar.-Apr. 1967).

Rats and pigs were fed dried whole milk processed for removal of cationic radionuclides by ion exchange techniques. The thiamine, niacin, and vitamin B_6 contents were decreased by 50, 27, and 15% respectively, and K content increased 80% compared with the control milk. There was no significant difference in rate of growth or in blood serum cations, in either rats or pigs, between animals fed processed whole milk or fed the control whole milk. There was significantly greater urine K excretion from pigs fed processed milk or control milk plus K citrate as compared with pigs fed the control whole milk. One experiment showed a significantly greater excretion of Na from pigs fed control whole milk plus K citrate as compared with pigs fed control whole milk. On the basis of earlier chemical analyses and these feeding experiments, the ion exchange treatment of milk for removal of cation radionuclides does not seriously affect the nutritive qualities of bovine milk. (BBB)

34664 NUTRITIONAL EVALUATION OF MILK PROCESSED FOR REMOVAL OF CATIONIC RADIONUCLIDES. CHEMICAL ANALYSES. Isaacks, R. E. (Veterans Administration Hospital, Coral Gables, Fla.); Hazzard, D. G.; Barth, Julius; Fooks, J. H.; Edmondson, L. F. J. Agr. Food Chem., 15: 295-9(Mar.-Apr. 1967).

A method for removing cationic radionuclides from milk was developed that results in limited changes in cationic composition, physical appearance, and organoleptic properties of the milk. An assessment of the nutritive quality of milk from such a treatment was made with 2 approaches: chemical analyses, and feeding studies with subsequent biological analyses. Chemical constituents of milk treated with Amberlite IR-120 resin, in the CaMgKNa cycle, were studied. Comparisons of results obtained on control and resin-treated milk showed no significant change in total solids, butterfat, protein, flavor quality, carotene, vitamin A, riboflavin, pantothenic acid, folic acid, or vitamin B_{12}. The ash, K, and citric acid contents of the resin-treated milk increased ~14, 80, and 100%, respectively, compared with control milk. The thiamine, niacin, and vitamin B_6 contents of the processed milk decreased 50, 27, and 15%, respectively. About 86% of the free thiamine and 20% of the bound thiamine were removed by resin treatment. Copper content of the resin-treated milk was reduced 23%. (BBB)

34665 STUDIES ON THE REMOVAL OF ^{137}Cs FROM MEAT. Burakowski, T.; Cieplinski, J.; Derecki, J. Med. Weter. (Poland), 22: 133-6(1966). (In Polish).

Studies on the removal of cesium-137 from contaminated meat are described. It was found that tap water works almost as effectively as distilled water. Among organic chemicals, which are more effective than inorganic chemicals, best results were obtained with citric acid and sodium salicylate. The most practical way of decontamination was found to consist in steeping contaminated meat in tap water for several hours. (JPRS)

34666 DOSE VERIFICATION STUDIES IN RADIUM THERAPY OF CARCINOMA OF THE CERVIX. Nathanson, Bernard N.; Liegner, Leonard M.; Rudolph, John D.; Hodara, Morris (St. Luke's Hospital Center, New York). Amer. J. Obstet. Gynecol., 97: 808-16(Mar. 15, 1967).

Dosimeter studies were made in 3 patients to check estimates of Ra doses in treatment of carcinoma of the cervix. Miniaturized dosimeters were placed at selected surgical-anatomic points in patients undergoing extraperitoneal lymphadenectomy and Ra implantation. In general, the physicist's calculated doses to the critical points were in satisfactory agreement with direct readings taken from the microdosimeters left in situ during treatment. Silver-activated glass rod and thermoluminescent dosimeters were used. It was evident that there are technical limitations inherent in dosimeters of all types. The glass rods were damaged during catheter loading and unloading in 1 case. Exposure of the rods to diagnostic x rays when localization films are taken may yield an artifactually induced higher reading secondary to energy dependence, especially so if multiple exposures are required. Thermoluminescent lithium powder in nylon capsules is probably the most reliable method of microdosimetry. Direct probe meter dosimetry at points close to the Ra source can be rather grossly unreliable unless careful positioning can be assured. (BBB)

34667 SYSTEMS FOR REMOVING RADIONUCLIDES FROM MILK. Glascock, R. F.; Bryant, D. T. W. (National Inst. for Research in Dairying, Reading, Eng.). pp 85-98 of STI/PUB-135.

Various methods available for the removal of radionuclides from milk are surveyed and ion exchange methods are examined in greater detail. A pilot plant, which is based on that originally constructed at Beltsville near Washington, is briefly described and its performance is discussed. The plant has run more than 100 times over the past year without deterioration in the physical

properties of the resin. There is no indication that the passage of milk through the plant causes bacterial contamination, and radiochemical efficiency with respect to ^{85}Sr introduced either in vitro or in vivo is higher than 95%. The properties of the treated milk are given. It is concluded that although other processes such as electrodialysis might be applicable on a large scale (45,000 litres/d) experience with this plant (2250 litres/d) shows that a method based on the use of cation-exchange resins will reduce the concentration of radiostrontium and radiocaesium by a factor of ten. (auth)

34668 COMMERCIAL PROCESSING OF MILK FOR CONCURRENT REMOVAL OF CATIONIC AND ANIONIC RADIONUCLIDES. Bales, R. E.; Hickey, J. L. S. (Public Health Service, Rockville, Md.). pp 121-36 of STI/PUB-135.

The need for protecting the public from excessive internal radiation exposure in case of nuclear accidents or increased fallout has led the United States Public Health Service to investigate methods for removing radionuclides from milk. Through its own laboratories and through contracts with commercial firms in the dairy and chemical industries the United States Public Health Service has directed the development and construction of two processing plants for concurrent removal of ^{90}Sr and ^{131}I from fresh milk. One is a full-sized commercial fixed-bed ion-exchange plant with a capacity of more than 100,000 lb of milk per 8 hr. The other is a pilot plant with a capacity of 7000 lb/8 hr and uses the moving-bed ion-exchange process. The design characteristics and features of these plants are described. The laboratory and pilot-plant studies that served as a basis for design of these systems are also described and their results are reviewed. This includes data on efficiency of radionuclide removal, product acceptability, changes in the milk as a result of treatment, and sanitation factors in the process and equipment design. Problems with pH control, organoleptic quality, sanitation, and protein destabilization encountered in combinihg the cation-anion removal processes and in scaling up from laboratory-size to full-size systems are reviewed and discussed. The moving-bed processing plant is constructed in a configuration which may be mounted on a standard truck trailer. This unit could be quickly moved to any area for emergency use. This and other potential applications of these systems are discussed. Extensive tests of the wholesomeness, nutritional, and toxicological quality of the treated milk are being made. This testing program is outlined and results to date are presented. (auth)

34669 RADIOACTIVE CONTAMINATION OF PRODUCTS OF COW'S MILK. Kirchmann, R.; Adam, V.; Van Puymbroeck, S. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp 189-98 of STI/PUB-135. (In French).

Studies of the artificial radioactive contamination of the environment have shown that milk is a vulnerable link in the human food chain. To evaluate the possibilities of using milk contaminated at levels in excess of the standards prescribed for direct human consumption and also to ascertain whether the distribution of the most important radionuclides (Sr, Ca, I) is identical in products made from milk contaminated in vivo and in vitro, a number of laboratory experiments were performed that were geared to the technological processes used in the dairy industry. Descriptions are given of the modes of contamination of the milk as well as the technological processes imitated. Gamma spectrometry was used to measure the contents of ^{85}Sr, ^{131}I, and ^{134}Cs in different samples. The radiostrontium contamination of cheese-type products made from milk contaminated in vivo is very strongly influenced by the mode of coagulation (rennet, lactic acid fermentation); the addition of $CaCl_2$ does not affect the distribution. The mode of coagulation is of no importance in connection with milk contaminated in vitro. A study of the ratio of the concentrations of the radionuclides (product/whole milk) in skimmed milk, cream, butter, and buttermilk indicates that the mode of contamination of the milk has very little influence on the distribution of the radionuclides with the exception of the ^{131}I ratio for butter, which differs by a factor of over 2 depending on the mode of contamination. The paper compares radionuclides in various products and discusses the possibilities of using milk contaminated by fission products, the effects of the technological process employed on the radiocontamination level of certain products, and the differences observed between products made from milks contaminated in vitro and in vivo. (auth)

34670 THE STATE OF THE AUTOFLORA OF RATS IN ^{210}Po POISONING. Kuz'mina, T. D. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 204-10(1967). (In Russian).

Administration of polonium to rats in doses of 0.075 and 0.02 mCi/kg caused 100% deaths in 22 days and 4 to 5 months respectively. In both cases the animals' resistance to infection was seriously affected and there was a considerable increase of microbes in the autoflora on the skin and in the small intestines and mouth. The increase was evident before the appearance of clinical signs of disease and was especially marked just before death. Determination of the microflora of the skin and mouth is proposed as a very sensitive and early test of radiation sickness. (JPRS)

34671 DEPENDENCE OF $LD_{50/30}$ ON THE SPATIAL DISTRIBUTION OF X-RAY RADIATION DURING UNILATERAL IRRADIATION OF RATS. Avetisov, G. M. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 16-19(1967). (In Russian).

Data obtained by phantom dosimetry indicated that in non-uniform unilateral irradiation of rats with x rays, the $LD_{50/30}$ depends on the angle between the beam and the lengthwise axis of the animals' body. Variations of $LD_{50/30}$ with the angle of exposure were more pronounced on estimation of this dose in units of exposure dose than those of mean tissue dose. However, they were statistically reliable in the latter case as well. (JPRS)

34672 REPORT ON KERALA (INDIA), A REGION WITH HIGH BACKGROUND RADIATION. Rao, K. R. (Univ., Zurich). Radiol. Clin. Biol., 35: 373-80(1966).

A short review is presented of radiobiological investigations concerning Kerala (India), a region with concentrated deposits of monazite sand. Certain essential features of the reported observations on topics like location of monazite sand deposits, background radiation levels, uptake of radionuclides by plants growing in the region, and a dietary survey of the area in an effort to estimate the daily intake of activity by average man are presented. (auth)

34673 γ LABELLING WITH ^{85}Sr FOR IN VIVO MEASUREMENT OF ^{90}Sr. AN ATTEMPT FOR THE IN VIVO MEASUREMENT OF ^{90}Sr AND ^{90}Y IN INTERNALLY EXPOSED ANIMALS. Matsuoka, Osamu; Tanaka, Eiichi (National Inst. of Radiological Sciences, Chiba, Japan). Radioisotopes (Tokyo), 21: 261-8(Sept. 1966). (In Japanese).

In the study on the biological effect of internal exposure, the evaluation of absorbed dose due to deposited radionuclide in the organ of interest is essential. Strontium-90 is one of the most-studied radionuclides among the bone seeking isotopes, but its behavior in the living body is not clearly understood. The in vivo measurement of ^{90}Sr is rather difficult since this nuclide emits only low energy (0.545 MeV) β rays. The daughter nuclide, ^{90}Y, can be measured in vivo by detecting bremsstrahlungs of its high-energy (2.26 MeV) β rays, and if ^{90}Y exists in equilibrium with ^{90}Sr, the amount of ^{90}Sr can be determined by the bremsstrahlung counting technique. However, it is expected that detailed behavior of ^{90}Sr and ^{90}Y in the living body is not identical. A new γ-labeling method was developed to determine the amount of ^{90}Sr in vivo. A mixture of ^{90}Sr and small amount (2 to 5% in activity) of ^{85}Sr is administered to the animal and the γ rays (0.513 MeV) from ^{85}Sr are measured with a scintillation counter. The counting efficiency should be determined beforehand with the original mixture solution. Yttrium-90 activity existing with ^{90}Sr is measured by its bremsstrahlung effect if necessary. Discussions are included on the several technical problems in the application of γ-labeling; characteristics of bremsstrahlung measurement; optimum mixing ratio; and its practicability and dose contribution from labeling isotopes. This method was applied to the study of the effects of internal exposure of ^{90}Sr on the whole-body retention of ^{90}Sr itself. It was demonstrated that the whole-body retention of ^{90}Sr is influenced by administered dose level of ^{90}Sr itself. The γ-labeling method is also applicable to the determination of the equilibrium ratio, $^{90}Y/^{90}Sr$, by the fact that the amount of ^{90}Y can be determined separately by the bremsstrahlung counting technique with a scintillation spectrometer. By this method the equilibrium ratio, $^{90}Y/^{90}Sr$ in a rabbit bone was determined as a function of time after administration of equilibrated ^{90}Sr-^{90}Y solution. The detector was surrounded with 1 mm copper in order to cut the low-energy part of the bremsstrahlungs and to reduce the effect of the characteristic x rays emitted from the lead shield. The pulse-height distribution was obtained with a 100 channel pulse-height analyzer. The results obtained with oral administration and with i.v. injection are reported. Although the ratios reached unity at about two weeks after administration, their transition curves showed quite different patterns depending upon the type of administration. (NSA of Japan)

34674 ATOMIC ENERGY: BENEFITS AND PRECAUTIONS. McLean, A. S. (United Kingdom Atomic Energy Authority, London). pp 4-8 of Radiation Levels: Air, Water, and Food. London, Royal Society for the Promotion of Health, 1964.

Environmental radiation hazards are discussed, particularly with reference to public attitudes toward radiation, maximum permissible levels, and the role of public health agencies in surveillance of the hazards. There are about 200 artificial radionuclides in the environment, each with its own physical and chemical char-

acteristics and radiotoxicity. By many routes, and in various materials, trace quantities of some of them will reach human bodies. The fate in the body of these trace quantities depends on such factors as their solubility, the tissue in which they tend to concentrate, and their residence time in the body. A few radionuclides are the major sources of internal contamination (for example ^{90}Sr, ^{131}I, and ^{137}Cs). A radionuclide may be both inhaled and ingested in food and water, but one mode of entry is usually predominant. In the case of diet, only a few significant foodstuffs are affected so that every component of the diet need not be separately considered to the same extent. The groups of the population requiring greatest consideration are young children and pregnant women. It is suggested that it is the responsibility of public health authorities to protect the public from unnecessary harmful exposure to ionizing radiation; to protect the public from harmful propaganda about it; and to protect the public from unnecessary and harmful interference with their ability to enjoy the many benefits that ionizing radiation can bring now and in the future. (BBB)

34675 ADMINISTRATION OF RADIOLOGICAL HEALTH PROGRAMS WITHIN THE STATE GOVERNMENT. Pickard, Ralph C.; Fry, Richard M. (Kentucky Health Dept., Frankfort). Amer. J. Public Health, 57: 290-4(Feb. 1967).

Administrative aspects of a radiation surveillance department are considered, with emphasis on staff, equipment, budget, modus operandi, legislation and regulations, goals, and reports. A multidiscipline program is necessary because of the complex interrelations between radiological health, medical and dental practice, engineering, transportation, industry, labor, agriculture, civil defense, space exploration, and other regulatory organizations. It is helpful to have a variety of backgrounds represented on the radiological health staff, such as persons with backgrounds in biology, chemistry, medicine, and physics. Facilities required for a radiological health program and the procurement of radiation monitoring and measuring equipment are discussed. An important point in the selection of instrumentation is the ease of maintenance or the availability of qualified personnel to assure accurately functioning equipment at all times. It is important that state statutes be soundly established to develop a program under proper legislation. (BBB)

34676 ABSORPTION AND REMOVAL OF SIMULATED FALLOUT (^{90}Sr) FROM POTATOES. Stinson, William Sickman, Jr. Columbus, Ohio, Ohio State Univ., 1966. 98p.

Thesis.

The main objective of the study was to determine the effect of variety, location, and specific gravity on the absorption of ^{90}Sr by potato tubers treated in a solution of ^{90}Sr. A secondary objective was to study the effectiveness of two different peeling methods on the removal of ^{90}Sr from treated potatoes, and to learn how effectiveness of the method varied with the variety, location, and specific gravity of the potatoes. Thirteen varieties were selected for the study on the basis of their relative time of maturity. The varieties used were Fundy, Superior, Irish Cobbler, Snowflake, Early Chippewa, Plymouth, Arenac, Pennchip, Kennebec, Katahdin, Sebago, Russet Sebago, and Ona. The potatoes used in this study were obtained from eight different locations within the state of Ohio. A six-pound representative sample of each variety from each location was taken. From this six-pound sample, five pounds were soaked in a solution containing 0.08 μCi ^{90}Sr and distilled water for three minutes. The six-pound sample was divided and designated as follows: one pound for ^{90}Sr unpeeled control, two pounds for abrasive peeling, two pounds for lye peeling, and one pound for untreated control. Two peeling methods were employed: abrasive peeling and hot lye peeling. After the potatoes were peeled, they were wrapped in aluminum foil and frozen until time permitted for plancheting. The frozen potatoes were thawed and cut into ¼-inch cubes and dried. The dried cubes were placed in a blender and ground for five minutes. A 2½-gram sample of the potato powder was mixed with 2½ milliliters concentrated HCl and 12 milliliters of distilled water and boiled for three minutes. One milliliter of the potato solution was pipetted into a two-inch planchet and dried for one and one-half hours at a temperature of 100 to 110°C. The planchets were counted in a Tracerlab/Omni/Guard 2 anticoincidence gas flow counter for 100 minutes in triplicate. The conclusions drawn from this study follow. There was no significant difference due to variety on the amount of ^{90}Sr absorbed. This could be explained partially by the fact that the varieties were not uniform from location to location in composition and morphology. Location was significant at the 0.01 level in its effect on the amount of ^{90}Sr absorbed by the tubers. It was believed that location as it affected specific gravity influenced the amount of ^{90}Sr absorbed. There was a highly significant negative correlation between specific gravity and the amount of ^{90}Sr absorbed. The reason for this correlation was believed to be due to differences in permeability of the periderms to the ^{90}Sr solution. There was a significant difference at the 0.01 level between the two peeling methods in the amount of ^{90}Sr removed. The lye peeling method was much more effective, with an average removal of 99.8 per cent, than the abrasive method, with an average of 93.7 per cent removed. An analysis of the study indicated that the in-plant removal of ^{90}Sr from potatoes that had been contaminated by fallout from a nuclear attack would be feasible. A mechanical system of lye peeling could be established in which there would be no need for personal contact with contaminated potatoes. In addition, a monitoring system could be set up so that as the potatoes are peeled, they would be checked for any remaining fallout. (Disser. Abstr.)

34677 RADIOLOGICAL HEALTH PROGRAM GUIDE. Contract PH 86-65-99. Rockville, Md., Department of Health, Education, and Welfare, 1966. 99p.

Prepared by The Southern Interstate Nuclear Board for National Center for Radiological Health, Bureau of Disease Prevention and Environmental Control, Public Health Service, Rockville, Maryland.

The technical aspects of radiation protection and related disciplines are discussed in relation to governmental control policies. The relative roles of the state and Federal governments in radiation protection of the civilian population are set forth. The basic components, methods for development, legislative approaches, and monetary requirements of state radiological health programs are discussed and outlined. (B.H.S.)

Medicine

Refer also to abstracts 34628, 34778, 34813, and 34815.

34678 (AD-637575) MODIFICATION OF THE RADIATION INDUCED INCREASE IN ADENOSINE TRIPHOSPHATASE ACTIVITY OF THE SPLEEN BY VARIOUS CHEMICAL AGENTS. Report for December 1, 1965-May 31, 1966. Tardiff, Robert G.; DuBois, Kenneth P. (Chicago Univ., Ill. Toxicity Lab.). June 1966. Contract AF 41(609)-2977. 29p. CFSTI.

A study was conducted on the influence of various chemical agents agents and biological preparations on the radiation-induced increase in adenosine triphosphatase activity of the spleen of rats using cobalt gamma radiation exposures. Exposure of rats to 21.2 R and 50 R per day over a 10-hour period caused dose-dependent increases in enzyme activity. Progressive increases occurred during the first few days followed by maintenance of the activity at a constant elevated level. Chemical agents were tested for protective activity by exposing rats to a total dose of 200 R at the rate of 50 R per day that resulted in an increase in enzyme activity of the spleen to 186% of normal. Cysteine, mercaptoethylamine, and AET were relatively ineffective in reducing the amount of change in enzyme activity in contrast to their protective effects against acute radiation injury. p-Aminopropiophenone, hydroxylamine, thyroxin, and thyroid stimulating hormones were effective antagonists of the radiation-induced injury. Progesterone and adrenal cortical extract exerted some protective action. A yeast extract and the water-soluble fractions of liver exerted marked protective effects when given parenterally but were ineffective when given orally. (auth)

34679 (NP-16780(Vol.1)(Pts.2-3)) A BIBLIOGRAPHY OF ONCOLOGY. VOLUME I. PART 2. A BIBLIOGRAPHY. PART 3. AUTHOR INDEX. Review Report No. 27. Skurzak, H.; Gadek, A.; Jasinski, W. (Instytut Onkologii, Warsaw (Poland)). 1967. 328p. (In Several Languages). Dep.

A bibliography containing 2500 references on neoplasms is presented. Among the topics covered are the following: chemotherapy, nuclear medicine, radioinduction, radiodiagnosis, and radiotherapy. (W.E.B.)

34680 (TID-23834) ENZYMATIC CLEAVAGE OF THE ETHER BOND OF ALKOXYGLYCEROLS BY A SOLUBLE PROTEIN FRACTION OF LIVER AND OTHER TISSUES. Pfleger, Raymond Charles (Oak Ridge Associated Universities, Tenn.). 1967. 199p. Dep. CFSTI.

Thesis. Submitted to Univ. of North Carolina, Chapel Hill.

Investigation of the catabolism of the ether bond of ^{14}C- and ^{3}H-labeled 1- and 2-isomers of alkoxyglycerols (glyceryl ethers), in vivo and in vitro, showed extensive cleavage of the ether bond in rat liver. Six hours after intravenous injection, 13% of the ^{14}C from 1-chimyl alcohol and 6% from 1-batyl alcohol were present in the liver; approximately 99 and 94% cleavage of the ether bond occurred in the respective glyceryl ethers. Incubation with rat liver slices confirmed qualitatively the in vivo results. Based on electron microscopy and isopycnic-zonal centrifugation, results showed that enzymes for cleavage of the ether bond reside in the soluble fraction of hepatic cells rather than in the microsomes, as previously reported. Mitochondrial supernates from rat

intestines, perirenal fat, and brain contained a much lower "etherase" activity than that of the liver. Livers from male rats cleaved glyceryl 1-ethers at 1.68 times the rate of equal amounts of livers from female rats. The use of glyceryl ethers as radioprotective compounds is reviewed. (W.E.B.)

34681 CHROMOSOME ABERRATIONS IN LEUKOCYTES EXPOSED IN VITRO TO DIAGNOSTIC LEVELS OF X RAYS. Schmickel, Roy (Johns Hopkins Hospital, Baltimore). Amer. J. Hum. Genet., 19: 1-11(Jan. 1967).

The frequency of aberrations in human leukocytes exposed in vitro to low levels of x radiation was studied in an attempt to extrapolate to the in vivo incidence of chromosome aberrations seen in diagnostically irradiated persons. The value of certain chromosome aberrations as indicators of low radiation exposure is discussed, and the dose response is considered in terms of chromosomal targets. Blood samples from 12 normal donors were exposed to x-ray doses of 0 (control), 6, 12, 24, and 48 R. Following irradiation, phytohemagglutinin was added to the cells, and they were incubated for 70 hr prior to mitotic arrest with colchicine. The number of each chromosome aberration was listed for each level of radiation exposure in vitro. Chromosome aberrations proved to be sensitive indicators of exposure. Even at 6 R the number of cells with chromosome aberrations was significantly higher than that seen in controls. Rings and dicentric chromosomes alone were even more reliable indicators of irradiation of leukocyte chromosomes. The relatively high incidence of exchange aberrations at low levels suggested that some exchange aberrations may be caused by single ionizing rays. The clinical consequences of the radiation-induced chromosome aberrations are discussed. (BBB)

34682 THE CURRENT CONTRIBUTION OF RADIOBIOLOGY TO TREATMENT OF RADIATION INJURIES. Langendorff, H. (Univ., Freiburg i.B.). Roentgenpraxis, 20: 3-8(Jan. 1967). (In German).

Approaches to the treatment of radiation injuries, consisting of administration of living cells, chemical substances or nucleic acid preparations to protect against or reduce irradiation effects are reviewed. It is concluded that there has been no real solution to the problem of preventing or abating the effects of irradiation injuries, and that the results demonstrate that treatment of irradiation injuries is empirical, though encouraging. In the event of any large numbers of irradiation injuries, chemotherapy would be the most practical mode of treatment since cell suspensions would be extremely difficult to provide. (BBB)

34683 IONS OF HEAVY METALS AS RADIOPROTECTORS AGAINST RADIATION DAMAGE OF PLANTS. Vlasyuk, P. A.; Grodzinskii, D. M.; Gudkov, I. N. (Inst. of Plant Physiology, Kiev). Radiobiologiya, 6: 591-7(1966). (In Russian).

Radioprotective and therapeutic effects of di- and trivalent Fe, divalent Co, Mn, and Ni were studied in barley, beans, peas, and wheat and in isolated plant organs irradiated with ^{60}Co γ rays at 500 rad and 50 krad doses. In order to eliminate anion effects the seeds were treated with chloride solutions of the metals. The seeds were treated with the chloride solutions before and after irradiation. Studies of Fe content showed that after treatment with iron chloride solution the content of iron increased in all parts of the pea seed. The protective effects of the metals were compared with the 0.01 to 0.001 M solutions of cysteamine and cysteine. The results indicated that some of the examined metals clearly exhibited radioprotective properties. (R.V.J.)

34684 RADIOISOTOPE METHOD FOR EVALUATION OF THE BLOOD SUPPLY OF THE FEMUR HEAD AFTER FEMORAL NECK FRACTURES. Scoccianti, P. (Univ., Florence). Arch. "Putti" Chir. Organi Movimento, 21: 364-75(1966). (In Italian).

A method using ^{85}Sr to examine vascularization of bone fractures was developed and applied to the clinical study of 20 cases of fractures of the femoral neck. Strontium-85 was injected intravenously, as the chloride, in doses of 35 to 40 μCi. The exposure to the patient with this dose was estimated to be less than 0.3 rad per week for 13 weeks. Instrumentation and external counting technique are described. Measurement of γ activity over the femoral head showed a ratio varying from 0.23 to 1.43 for the pathological/healthy sides in the 20 cases studied. The optimum time for recording radioactivity was at 72 hr postinjection. Subsequent tests in some cases did not show appreciable changes in vascularization of the fracture as shown by ^{85}Sr levels. (BBB)

34685 CLINICAL TRIAL OF RADIOTHERAPY AND HIGH PRESSURE OXYGEN. McEwen, J. B. (St. Mary's Hospital, Portsmouth, Eng.). Ann. Roy. Coll. Surg. Engl., 39: 168-71(Sept. 1966).

Experimental and clinical data demonstrating the radiosensitizing action of oxygen at high pressure are considered. The influence of oxygen on radiosensitivity was expressed as the ratio of the dose needed to produce a given degree of damage when cells were anoxic at the time of irradiation to that which sufficed to produce the same damage when cells had ample oxygen available. The oxygen enhancement ratio for γ radiation from ^{60}Co was between 2 and 3; e.g., when a dose of 6000 R was given uniformly throughout a tumor, anoxic but viable tumor cells sustained damage corresponding to an aerobic dose of 2000 to 3000 R and remained capable to reproduction. The most practical method of raising oxygen tension in the cells was to raise the partial pressure of oxygen in the respired air. A clinical trial was designed to determine whether the survival time of patients with carcinoma of the lung or of the urinary bladder, treated by radiotherapy in oxygen at a pressure of 3 atm abs, was better than that of a similar group of patients treated by identical radiotherapy in air at atmospheric pressure. Preliminary findings indicated a worsening prognosis with oxygen therapy in irradiated bladder tumor patients and no difference in those with lung tumors. (BBB)

34686 THERAPEUTIC USES OF HYPERBARIC OXYGEN. Churchill-Davidson, I. (St. Thomas' Hospital, London). Ann. Roy. Coll. Surg. Engl., 39: 164-8(Sept. 1966).

Theoretical and practical bases of the use of hyperbaric oxygen in radiotherapy are discussed. (TSS)

34687 INDUCED ALLOGENIC HEMATOPOIETIC CHIMERAS. Mathe, G. (Institut Gustave-Roussy, Villejuif, France). Triangle, Sandoz J. Med. Sci., 7: 131-5(1965).

The syndrome of allogenic bone marrow grafting in animals and in man is described. Also described are the medical applications of allogenic bone marrow grafting, as well as an instance of its use in six individuals accidentally irradiated at the Vinca Center in Yugoslavia by a mixture of γ rays and neutrons. The dose of radiation based on the physical, clinical, hematologic, and histologic data was estimated to have exceeded the LD_{75} in five of those irradiated and the LD_{30} in one of them. The individuals were treated by allogenic bone marrow transfusions that were administered at different time intervals after irradiation. The transfusions were followed by myeloid restoration that was attributed to grafting of the transfused cells. The therapeutic value was apparent from the fact that only one of the patients died, even though five of them had received a dose exceeding the LD_{75}. Moreover the patient who died showed excellent myeloid restoration and died from intestinal radiolesions. None of the patients developed the secondary syndrome, probably because of the transitory nature of the grafts. (BBB)

34688 QUANTITATIVE STUDIES OF LATE RADIATION CHANGES IN HEMATOPOIETIC ORGANS OF RFM/U AND BALB/c MICE AND THEIR RELATION TO LEUKEMIA. Ludwig, Frederic C.; Wellington, John S.; Elashoff, Robert M.; Smoke, Mary E. (Univ. of California, San Francisco). Lab. Invest., 16: 383-94 (Mar. 1967).

A comparison was made of the incidence of leukemia and extent of nonmalignant late radiation injury in an inbred mouse strain in which radiation leukemia can be readily elicited (RFM/U) and in an inbred strain that is relatively resistant to the induction of this disease (BALB/c). Half of the animals of each strain were spleen-shielded during irradiation. Nonleukemic animals were sequentially sacrificed to measure the extent of nonmalignant late radiation injury in bone marrow, peripheral blood, and lymph nodes. Both whole-body irradiated and spleen-shielded mice received a single exposure of 300 rad of 250-KV x rays. The principal changes seen in the marrow were depression of the number of erythroblasts and the mature myeloid cells, paralleled by a rise of the myeloid precursors above control levels, presumably as an expression of overregeneration of the white cells and maturation arrest. The late changes observed in the myelopoietic series were of borderline significance in the BALB/c strain, which is relatively resistant to the induction of radiation leukemia, but were conspicuous in the RFM/U strain, in which radiation leukemia readily develops under the same conditions. Similar late changes were observed in lymph nodes of both mouse strains, but they did not reflect the quantitative strain difference noted in the bone marrow changes. Whether these late, nonmalignant radiation changes in the bone marrow played a role in the pathogenesis of radiation leukemia in the RFM/U mouse is discussed. Spleen-shielding during irradiation, which had the expected inhibitory effect on the incidence of leukemia, did not inhibit nonmalignant late effects but modified them in a complex manner. (BBB)

34689 SULFOXIDE PROTECTION OF BACTERIOPHAGE AGAINST X-IRRADIATION INACTIVATION. Lockingen, Lloyd S. pp 501-3 of Studies in Genetics. III. Wheeler, Marshall R. (ed.). Austin, Tex., University of Texas, 1966.

Dimethyl sulfoxide, diethyl sulfoxide, diethyl sulfone, and diethyl sulfide were tested for their protection of bacteriophage T2r from inactivation by x radiation. The chemicals were added to the phage 10 min before irradiation with doses ranging from 10 to 90 R. The

sulfoxides and sulfide protected against inactivation in concentrations as low as 0.001 μ. Diethyl sulfide was the most radioprotective. Diethyl sulfone had no protective effect, but it did enhance inactivation when used in a 1.0 μ concentration. The results are consistent with the hypothesis that the electronic configuration about the sulfur atom determines whether the compound will be radioprotective. (M.M.B.)

34690 DIMETHYL SULFOXIDE TREATMENT OF DROSOPHILA. Alexander, Mary L. pp 505-16 of Studies in Genetics. III. Wheeler, Marshall R. (ed.). Austin, Tex., University of Texas, 1966.

Other workers have shown that dimethyl sulfoxide has a radioprotective effect on survival in mice and inactivation in bacteriophage. The degree of protection in mice was dependent on time and was maximum within an hour after treatment. An investigation of the effect of dimethyl sulfoxide on radioinduced genetic damage in adult male Drosophila melanogaster is described. Young adult male abdomens were dipped in concentrated dimethyl sulfoxide and exposed to x-ray doses of 4213, 1674, and 2000 R 4 to 5 hr later. Others were injected with .0004 ml of a 10^{-1} M solution of dimethyl sulfoxide 4 to 5 hr before exposure to a 2000-R x-ray dose. Others were developed from eggs on a diet supplemented with 0.5% dimethyl sulfoxide before exposure to a 2000-R x-ray dose. Genetic damage was evaluated by measuring dominant lethals, translocations, or sex-linked recessive lethals after mating treated males. None of the chemical treatments protected against radioinduced genetic damage. It is suggested that the 4-hr period between chemical treatment and irradiation may be too long for the detection of radioprotective effects. (M.M.B.)

34691 THE ROLE OF RADIOTHERAPY IN THE TREATMENT OF BRAIN TUMORS. Mollihan, William V.; Moss, William T.; Heiser, William J. (Wesley Memorial Hospital, Chicago). Dis. Nerv. Syst., 28: 89-93(Feb. 1967).

Radiosensitivity of various brain tumors and different components of the brain are discussed, with emphasis of means whereby radioinduced brain injury can be prevented. The anterosuperior segment of the brain can be treated with relatively little risk to a dose of 5000 to 5500 rad in 5 to 6 weeks. The posteroinferior segment can safely be treated to a dose of about 4500 rad in 4 weeks. The brain stem limits exposure of this volume to a higher dose. A scale of radiation tolerances is presented based on the combination of the apparent radiosensitivity of the area in question and relative functional importance of the area. Vital areas in the brainstem are moderately radiosensitive. Radioinduced damage results in either severe disability or death. Therefore, regardless of the aim of therapy, the upper limit of dose is set at 4500 rad in 5 weeks. Of intermediate tolerance are other selected areas of major functional importance but not essential for life, including the motor cortex in this category. Radiosensitivity of this area is significantly less than that of the brainstem. The dose limit for palliation is 4500 rad in 5 weeks. The dose limit when cure seems possible is 6000 rad in 6 weeks. In the 3rd category are certain areas of less functional importance, including the frontal and occipital portions of the cerebrum. High doses can be given to these areas with acceptable sequelae. The dose limit is therefore set at 6000 to 7000 rad in 6 to 7 weeks. (BBB)

34692 RENAL CHANGES AFTER DIRECT IRRADIATION OF THE KIDNEY IN MAN. Paces, V.; Klimova, M. (Nemocnice Bulkovka, Prague). Urol. Int., 21: 511-19(1966).

Histopathological studies were made in the kidneys of 22 patients with renal tumors after pre-operative x irradiation of the kidney with a dose of 4000 R. Nephrectomy was carried out 21 to 30 days after the last irradiation dose. In 27 patients who had not been subjected to the radiation treatment, similar studies were made. In none of the cases was any specific damage of the glomerulus seen. Lesions of the tubular epithelium, on the other hand, were frequent. A whole range of changes was seen, ranging from hyaline droplet degeneration, which occurred most frequently, to vacuolar degeneration and even necrosis of some segments of the tubules. Damaged renal tubules were seen in 11 kidneys; only in 3 cases was injury related to chronic pyelonephritis. Pronounced necrosis of the tubules was found in only 1 case. In unirradiated kidneys a marked change of tubular epithelium was found in only 1 case, indicating that the described lesions of the kidney were due to irradiation. Changes of the blood vessels were more complicated because of associated arteriosclerotic changes and those of the chronic inflammatory process. In all cases they were characterized by thickening of the walls of the small arteries and a reduction of their lumen. When the kidney was irradiated prior to the operation the arteries of medium and smaller caliber particularly were involved. The arterioles were not at all affected. In 10 patients who showed no clinical symptoms of arteriosclerosis or chronic pyelonephritis prior to irradiation, edema of the arterial wall as well as the other described changes were found in 8 kidneys, 3 of which also showed histological changes of arteriosclerosis. In 6 patients who also showed arteriosclerotic changes, it was impossible to discern which changes were due to irradiation and which to arteriosclerosis. Observations in the patients with kidneys free of clinically ascertainable chronic inflammatory and degenerative changes revealed that irradiation first affects renal vessels and epithelium of the renal tubules. If renal vessels were affected by sclerosis, irradiation injured such vessels much more intensively than normal vessels. (BBB)

34693 TREATMENT OF POLYCYTHEMIA BY ^{32}P. Ledlie, E. M. (Royal Cancer Hospital, London). Proc. Roy. Soc. Med., 59: 1095-1100(Nov. 1966).

Dose measurement, doses administered, effects and side-effects of ^{32}P, and deaths attributable to treatment are reported for 132 cases of polycythemia. A total-body counter was used to count the Bremsstrahlen from ^{32}P and thus to measure directly the total-body dose in one patient treated with radiophosphorus. The patient had been given 4.9 mCi of ^{32}P intravenously. The half-time was shown to be 11 days and the whole-body dose calculated to be 47 rem. A single dose of ^{32}P is often sufficient for a remission, but if necessary a second slightly smaller dose can be given not less than 6 weeks later. The average first dose was 5 mCi. Small fractionated doses, that is 1 or 2 mCi once a week, were tried in an attempt to obtain reduction of the cell count with a lower total dose of ^{32}P, but this objective was not realized. Ineffective small doses of ^{32}P add to the amount of total-body irradiation administered without achieving any useful purpose and should be avoided. Among the few women of child-bearing age treated with ^{32}P, no pregnancy has been reported. Among the men the evidence concerning the possible effect of ^{32}P in reducing fertility is equivocal. Sixty-five of the 132 patients have died. One-third of the patients died from marrow failure. It has become clear that the proportion of radiophosphorus-treated patients dying from marrow failure is higher than in untreated ones. The marrow shows hypo- or hyperplasia, myelofibrosis, excessive blast cell formation, granulocytosis, or megakaryocytosis. In a few cases the peripheral blood picture showed a sudden rapid deterioration with the appearance of primitive cells, including blasts. Death from marrow failure occurred early or late in the course of the disease and was not apparently related to the overall dose of ^{32}P given. It is concluded that there is no absolute contraindication to ^{32}P in any patient with Polycythemia vera. (BBB)

34694 PROGRESSIVE STUDIES OF BRAIN TUMORS WITH RADIOACTIVE ISOTOPES. Wende, Sigurd (Freie Univ., Berlin). Acta Radiol., Diagn., 5: 928-35(1966). (In German).

The effectiveness of radiotherapeutic measures in malignant cerebral neoplasms can be followed by radioisotope encephalography. A reversible impairment of the permeability of the blood-brain barrier was used to facilitate favorable treatment of a left frontal glioblastoma. After irradiation with 2500 R of x ray, the region of radioisotope accumulation increased. Along with this the patient's clinical condition worsened markedly. After 5000 R of x irradiation, radioisotope accumulation increased further. A circumscribed, increased impairment of the bloodbrain barrier was observed in the tumor area. By 9 weeks after the irradiation treatment the patient was found to be essentially tumor free, as shown by a γ encephalogram at that time. In a second patient, with an oligodendroglioma who was scanned before and after treatment with 2500 R of x irradiation, the tumor regressed. After 500 R of x irradiation there was an additional regression as indicated by γ encephalography, but 10 weeks later, neurological symptoms worsened. The tumor was found by encephalography to have enlarged. (BBB)

34695 VISUALIZATION OF THE CHOROID PLEXUS ON THE ^{99m}Tc BRAIN SCAN: CLINICAL SIGNIFICANCE AND BLOCKING BY POTASSIUM PERCHLORATE. Witcofski, Richard L.; Janeway, Richard; Maynard, C. Douglas; Bearden, Emmett K.; Schultz, John L. (Bowman Gray School of Medicine, Winston-Salem, N. C.). Arch. Neurol., 16: 286-91(Mar. 1967).

A method for using ^{99m}Tc-pertechnetate for brain scanning which avoids interference from radioisotope in the choroid plexus is presented. The practicality of utilizing ^{99m}Tc pertechnetate as an agent for brain scanning is discussed. The short half-life of the ^{99m}Tc makes possible the administration of millicurie doses of the radionuclide which, at the same time, causes only minimal radiation dose to the patient. The high count rates associated with large doses make rapid scanning possible. Further, its 140-kev γ emission is easily collimated for good resolution. Sodium pertechnetate (^{99m}Tc) is handled by the body in the same fashion as the iodide ion, and actively accumulated by the thyroid gland, stomach, and salivary glands. Lugol's solution and potassium perchlorate can be used to block this active concentration and thus reduce the radiation dose. With use of pertechnetate in routine brain scanning, a scan pattern of symmetrical accumulation in the region of the

choroid plexus was noted. Prior administration of perchlorate prevented this accumulation. This implies an active concentration of ^{99m}Tc-pertechnetate by the choroid plexus. Because potassium perchlorate is not routinely used for blocking other organs in many laboratories using pertechnetate for brain scanning, the appearance of the choroid plexus may lead to false positive brain scans. Routine use of perchlorate or repeat scans with perchlorate can obviate this interference. (BBB)

34696 SOFT-TISSUE RECURRENCE OF GIANT-CELL TUMOR OF BONE AFTER IRRADIATION AND EXCISION. Riley, Lee H. Jr.; Hartmann, William H.; Robinson, Robert A. (Johns Hopkins Univ., Baltimore). J. Bone Joint Surg., 49A: 365-8 (Mar. 1967).

The possibility of malignant tumors developing after irradiation of benign bone tumors is considered. Two cases are described which illustrate this complication occurring after treatment of giant-cell tumor of bone by irradiation and excision. The first patient, a woman 36 yr old, received 33 x radiation treatments to a biopsy-proved giant-cell tumor of the left innominate bone. The exact dose of radiation delivered to the tumor was not known. In case 2, a man 25 yr old had had, at the age of 18, a lesion of the head of the left ninth rib surgically excised which proved to be a giant-cell tumor. The tumor bed was treated with 2125 R of conventional x radiation given in 13 treatments over a two-week period. Five yr later recurrent tumor was excised from the epidural space from the sixth through the eleventh thoracic vertebra and the patient was given external beam ^{60}Co treatment, the estimated dose being 4000 R. Several yr later a nodule was excised and proved to be giant-cell tumor which now demonstrated histological evidence of malignancy. The patient died and extensive disseminated tumor was noted at autopsy. In both of these cases the primary lesion had been irradiated before the surgical procedure during which wound implantation occurred. Previous radiation treatment of the primary lesion may have been a factor in the later demonstrated ability of the lesion to recur locally as a discrete soft-tissue nodule, but this association could not be definitely established on the basis of the 2 cases reported here. However, there is strong suggestive evidence in the literature that giant cell tumor of bone may respond to radiation treatment by assuming clinical and microscopic characteristics of sarcoma. Thus, in one report of 116 cases of giant-cell tumor, sarcoma arose in 10 of these cases, 9 of which had received x-ray therapy prior to the conversion of the lesion to a sarcoma. In a review of 24 of the authors' cases of giant-cell tumor of bone treated between 1925 and 1955 (not including the 2 cases reported here), sarcoma arose in 2 patients, both of whom had received radiation therapy prior to the conversion of the lesion to a sarcoma. (BBB)

34697 THYROID SCANNING: FURTHER APPROACHES. Spencer, Richard P. (Yale-New Haven Hospital). N. Y. State J. Med., 67: 1139-43(May 1, 1967).

The selection of radioiodine isotopes (^{125}I, ^{128}I, ^{130}I, ^{131}I, ^{132}I) and ^{99m}Tc to reduce the possible radiation hazard in thyroid scanning is discussed. There are no absolute contraindications to thyroid scanning. Pregnancy and lactation are relative contraindications, since radioiodide concentrates in the fetal thyroid after the third month of gestation and also enters the maternal milk. Short-lived radioisotopes may overcome the radiation hazard in such cases (for example, ^{130}I with a half-life of 12.6 hr, ^{132}I with a half-life of 2.3 hr, and ^{128}I with a half-life of 0.42 hr). Several iodine relatives from the seventh group of the periodic table are also concentrated by the thyroid gland. Technetium-99m has a half-life of 6 hr and can also be used for thyroid scanning. When the thyroid is to be studied, consideration must be given to the fact that radiation will be delivered to the gland. This means, as with many other diagnostic procedures, that the study should be done only on indication. Further, as small a quantity of radioiodide as possible should be employed. When feasible, the short-lived radioisotopes of iodine are preferred, and a number of analogs of iodide such as ^{99m}Tc may eventually be preferred. In terms of differentiating newly introduced radioiodide from that present from a previous study, 2 distinct radioisotopes can be utilized. For example, an initial thyroid scan may be performed with ^{125}I or ^{99m}Tc, and a repeat scan with ^{131}I which has a higher energy γ emission. Irradiation of the thyroid on repeated scans must be weighed against the benefits to be obtained from serial studies. (BBB)

34698 SELECTIVE LYMPHOPENIA IN MAN AFTER INTRALYMPHATIC INJECTION OF RADIOACTIVE ^{131}I-LIPIODOL. Edwards, J. M.; Lloyd-Davies, R. W.; Kinmonth, J. B. (St. Thomas's Hospital, London). Brit. Med. J., 1: 331-5(Feb. 11, 1967).

The effect on circulating lymphocyte levels of local irradiation of lymph nodes with ^{131}I was studied in 50 patients treated for melanoma with ^{131}I-Lipiodol. The dose scheme for a melanoma of the lower limb when the ilioinguinal and para-aortic glands were irradiated was 40 to 45 mCi in 4 to 4.5 ml Lipiodol. Brachial infusion to the axillary nodes usually entailed doses of 30 to 35 mCi ^{131}I in 2 to 2.5 ml Lipiodol. The radiation dose to the lymph nodes was estimated by direct measurement to be up to 100,000 rad. In some patients an absolute lymphopenia occurred in the early post treatment period, usually unassociated with depression of the total leucocyte counts. The only other change noted was the occasional elevated erythrocyte rate, and this appeared to be directly related to the level of spillover of radioactivity to the lung fields, as indicated by external scanning. Repeated leucocyte estimations showed a mild late depression of the total leukocytes occasionally, but this was not associated with a marked thrombocytopenia. Patients receiving endolymphatic ^{131}I-Lipiodol treatment to the ilioinguinal and para-aortic regions showed the most frequent and prolonged depression of both lymphocyte and leucocyte counts, but it had no clinical ill effects. (BBB)

34699 RADIOCHEMOPROPHYLAXIS IN ACUTE WHOLE-BODY RADIATION. Overman, Richard R.; Jackson, Sara Jean (Univ. of Tennessee, Memphis). Annu. Rev. Med., 18: 71-80 (1967).

This review, with 49 references, delineates the present status of radiochemoprophylaxis against whole-body irradiation in mammals, indicates some of the reasons for the status in quo, and suggests directions for future efforts aimed at both improving the practicality of radiochemoprophylaxis and widening the clinical usefulness of this approach. The compounds that have been tested, their effectiveness in various animal species, and the techniques used are discussed. This survey revealed that no single chemical compound nor combination of compounds can be effectively and safely employed to protect man against the lethal effects of whole-body irradiation. However, research on radiochemoprophylactic agents has contributed much to the progress of radiobiology in general and in particular to understanding of the complexity and the mechanisms of radiation damage. The early emphasis on protection against lethal radiation effects have caused neglect of other important clinical applications of radioprotection. It is suggested that future research should be focused on a more sophisticated approach to the toxicology of known radioprotective materials, clinically important applications of the radioprotective principle other than lethality (as tumor therapy), and use of animal species other than pure and inbred strains of small rodents. (BBB)

34700 PROGRESS IN THE CLINICAL USE OF RADIOISOTOPES. Hunter, Oscar B. Jr.; Foeckler, Francis H. Jr. (Hunter Memorial Lab., Washington, D. C.). Progr. Clin. Pathol., 1: 154-75(1966).

New methods in use of radioisotopes for functional studies and organ scanning are reviewed. Preferences for certain isotopes which allow for lower radiation exposure of the patient than others are outlined. The use of ^{132}I in the study of thyroid function following therapy with ^{131}I may be valuable in the prediction of clinical response to therapy with ^{131}I in hyperthyroidism. The ^{132}I can be measured in the presence of ^{131}I because of the higher energy γ rays of the former. Since the half-life of ^{132}I is only 2.3 hr, uptakes can be repeated on the same patient with little additional radiation dose to the thyroid. Practically all compounds of medical interest can now be obtained labeled with ^{125}I, which has a 60-day half-life and emits only photons of 27.4, 31, or 35.4 keV energy. Compounds labeled with ^{125}I have greater stability and longer shelf life than those labeled with ^{131}I. Another advantage of ^{125}I over ^{131}I is the lower radiation dose to the patient. In studies of intestinal absorption the chief disadvantages of ^{60}Co as a label for cyanocobalamine are the delivery of a higher radiation dose to the liver and the lower sensitivity to detection. These drawbacks are largely overcome by incorporation of ^{57}Co into vitamin B_{12}. It delivers a total radiation dose to the liver of 0.3 rad/μCi, while ^{58}Co gives twice as much and ^{60}Co about 29 times that of ^{57}Co. Development of so-called isotope cows (where a daughter isotope is produced from a mother isotope by decay) extends the production of short-lived isotopes with a half life of a few hours, of distinct advantage in radioisotope work. Also considered is the use of neutron activation for clinical studies. (108 references.) (BBB)

34701 RADIOACTIVE ISOTOPES IN LABORATORY MEDICINE. Warren, Shields (New England Deaconess Hospital, Boston). N.Y. State J. Med., 67: 897-901(Apr. 1, 1967). (NYO-3777-1).

Advances in use of radioisotopes in clinical diagnosis and research are reviewed, with attention of safety features of certain techniques and reduction of patient exposure by selection of radioisotopes. The hazards from fallout radionuclides are also reviewed. This discussion includes a brief description of studies which have been made of the kinds and amounts of fallout from the various series of nuclear tests, and of monitoring which is done through an extensive and well-organized network in the United

States. The amount of ^{90}Sr deposited monthly in New York City from 1954 to 1966 is reviewed. It is pointed out that certain populations have received significant amounts of fallout radiation. The 3 types of fallout (immediate, intermediate, and delayed), and their relative importance as a hazard to humans, are discussed. There is as yet only reasoning by analogy and extrapolation of data to indicate that the small doses of radiation from distant or stratospheric fallout may be deleterious. Efforts made to establish risk estimates from fallout, attempting to express a probable quantitative relation between doses of radiation and frequencies of occurrence of one or another effects, are considered. Risks from immediate fallout may be high, as was the case of the Japanese fishermen, but are in general low. Among the Marshallese exposed to fallout, 1 cancer of the thyroid has been found in an adult, and some children have developed benign nodules in their thyroid glands. Reconstruction of the dose received indicates that these persons were probably exposed to 175 rad of whole-body radiation and about 1000 rad of localized radiation to their thyroid glands. (BBB)

34702 POSTIRRADIATION FRACTURES OF FEMORAL NECK. Jankovic, Ljubisa; Cvetkovic, Svetozar; Rakic, Cvetko (Special Hospital of Infantile Paralysis and Bones and Joints Tuberculosis Banjica, Belgrade). Med. Pregl. (Novi Sod), 17: 653-6(1964). (In Serbian).

Case histories of two patients with radioinduced fractures are described. In both cases Ra and x ray treatment was given for gynecologic neoplasms. The x ray dose in the first case was 4200 R and in the second case 3500 R. Radiographic evidence of fractures of the femoral neck is illustrated, as are post-treatment films showing successful nailing of the fractured bone. These cases are cited to emphasize the relative frequency of this type of fracture in patients treated with x ray and Ra for malignant tumors of the pelvis. These fractures are often misinterpreted as pathological fractures due to metastasis complications. However, clinical features, laboratory investigations, and histopathological findings should suggest the correct diagnosis. Because of the gradual onset, the fracture does not impair to a great degree the blood supply to the fragments. This results in a rapid and firm union. The optimal treatment of the fractures without or with initial dislocation is bed rest, but in those with appreciable dislocation, an autograft or nailing may be required. (BBB)

34703 TIME-DOSE-FRACTIONATION RELATIONSHIPS IN RADIATION THERAPY. Marcial, Victor A. (Puerto Rico Nuclear Center, San Juan). Nat. Cancer Inst. Monogr., No. 24, 187-203(Feb. 1967).

Radiobiological aspects of time-dose-fractionation problems in radiotherapy and possible areas for research are considered. Experimental findings indicate that the greatest cellucidal effect is obtained by single dose irradiation; however, damage to normal tissues included in the irradiated volume is not well tolerated in the usual clinical situations of cancer radiotherapy and fractionation is required. This results in less efficient irradiation; the loss of effectiveness is related to the size and number of fractions, and to the time interval between them. This loss of cellucidal effect in animals and tissue culture systems is discussed. Various clinical fractionation schemes are examined in terms of radiobiological findings. It was concluded that present knowledge of time-dose fractionation relation in radiation therapy is incomplete. It is recommended that clinical trials be conducted to determine the optimal time-dose combination required to best control malignant neoplasms, relating this to irradiated volume and normal tissue effects; to determine tumor control rates and normal tissue damage with unorthodox fractionation; and to study the effects of administration of larger and fewer fractions in the early part of a treatment course for bulky anoxic tumors. Controlled studies should also be made for evaluating tumor curability and normal tissue preservation obtained when rest periods are used during radiotherapy; for the precise determination of the generation time of the various human normal and neoplastic tissues; and to investigate the recovery characteristics of human normal and cancerous tissues after various doses of radiation. (BBB)

34704 STUDIES ON SPLEEN OXYGEN TENSION AND RADIOPROTECTION IN MICE WITH HYPOXIA, SEROTONIN, AND p-AMINOPROPIOPHENONE. Hasegawa, Andrew T.; Landahl, H. D. (Univ. of Chicago). Contract AF41(609)-2977. Radiat. Res., 31: 389-99(July 1967).

Polarographic measurements of the oxygen tension in the spleen and vena cava, as well as radioprotection studies, were carried out in mice forced to breathe an atmosphere of low oxygen (10%, 7%, and 4.6%) or injected with serotonin (90 mg/kg) or p-aminopropiophenone (PAPP) (30 mg/kg). The spleen oxygen levels at 10%, 7%, and 4.6% oxygen were, respectively, 0.36, 0.27, and 0.10 of normal. The x radiation dose reduction factors at the corresponding levels were 1.24, 1.73, and 1.96. Serotonin reduced the oxygen tension to 0.53 of normal and gave a dose reduction factor of 1.77. PAPP reduced the oxygen tension to 0.35 of normal and gave a dose reduction factor of 1.74. A combination of serotonin and an atmosphere of 4.6% oxygen gave a dose reduction factor of 2.92. The results indicate that there is a small amount of protection by both serotonin and PAPP which is independent of hypoxia. (auth)

34705 INFLUENCE OF RADIOPROTECTORS ON THE RESPIRATION OF LIVER AND BRAIN MITOCHONDRIA OF RABBITS. Bicheikina, N. I.; Romantsev, E. F. Radiobiologiya, 6: 880-2 (1966). (In Russian).

An investigation of the effects of protectors on the respiration of mitochondria isolated from rabbit organs during administration of radioprotectors to healthy and irradiated animals (experiments in vivo) or after the addition of radioprotectors to a reaction medium containing a mitochondrial suspension (experiments in vitro) was conducted on 75 male rabbits. Animals were subjected to 800 R of γ radiation at a dose rate of 202 to 208 R/min. The radioprotectors studied were: in experiments in vivo, β-mercaptopropylamine (MPA), sodium nitrite (SN), and para-aminopropiophenone (PAPP); in experiments in vitro, β-mercaptopropylamine, and β-mercaptoethylamine (MEA). In the experiments in vivo, the compounds were administered intravenously 10 min before decapitation of the animals, in the doses exerting the maximum effect in the case of irradiation. The radioprotectors tested did not change the respiration of brain and liver mitochondria isolated from the tissues of healthy and irradiated animals. In the experiments in vitro, the radioprotectors were added immediately after 10-minute preincubation in the reaction mixture of Warburg vessels containing a mitochondrial suspension. β-Mercaptopropylamine in a dose of 118 micromoles inhibited brain mitochondrial respiration; in a dose of 23.6 micromoles it somewhat stimulated mitochondrial respiration. An analogous picture was observed on mitochondria from irradiated tissue, although the changes were less pronounced. Similar results were obtained on liver mitochondria; however, the lowest dose produced no change in the respiration of liver mitochondria from nonirradiated rabbits, whereas a substantial stimulation of respiration was observed in the case of mitochondria from irradiated rabbits. MPA and MEA, radioprotectors belonging to the same chemical class, aminothiols, and extremely close in chemical structure, when added to mitochondrial suspensions in identical amounts, exhibited selective action. Mercaptoethylamine did not influence the respiration of brain mitochondria; MEA and MPA equally inhibited the respiration of liver mitochondria. No definite relationship could be established between the inhibition of the respiration of brain and liver mitochondria after the addition of MPA and the change in the optical density of the suspension, associated with their swelling. (JPRS)

34706 COMPARATIVE DATA ON THE PROTECTIVE EFFECT OF CYSTEAMINE (MERCAPTOETHYLAMINE) AND AET (S-2-AMINOETHYLISOTHIURONIUM DIHYDROBROMIDE) AGAINST INTESTINAL RADIATION DEATH. Zsebok, Zoltan; Petranyi, Gyozo. Orv. Hetil., 107: 1257-61(July 3, 1966). (In Hungarian).

The protective mechanism of drugs was investigated by determining sodium sorption in the small intestine, the total and exchangeable extracellular sodium content, the inulin volume, and the sodium content of the serum. It was noted that AET and cysteamine prevent the loss of fluid and of sodium through two different mechanisms. These mechanisms were discussed. The significance of the findings in therapeutical improvements was described. (JPRS)

34707 EFFECT OF METHANDROSTENOLONE ON HISTOPATHOLOGIC POSTIRRADIATION LESIONS IN MICE. Jodczyk, Kazimierz; Kasprzycki, Konrad; Proniewski, Henryk (Zaklad Anatomii Patologicznej, Bialystok, Poland). Patol. Pol., 17: 37-49(Jan.-Mar. 1966). (In Polish).

The influence of methandrostenolone on the microscopic lesions in the liver, spleen, thymus, gonads, and bone marrow of mice with radiation disease was studied. In nonirradiated control mice methandrostenolone was administered through a stomach tube in doses of 1 mg/Kg body weight for 1 to 12 days. Methandrostenolone produced protein and vacuolar degeneration in the hepatic cells. In mice irradiated (160-kV x rays) with a dose of 180 R, lesions typical of radiation disease were observed. Administration of methandrostenolone in 1-mg/Kg doses for 12 days before and after irradiation diminished the symptoms of radiation disease and postirradiation histologic changes in the various tissues. Possible correlation of the protective property of this steroid with its ability to stimulate protein metabolism is discussed. (BBB)

34708 RADIOSENSITIVITY OF CERVICAL CANCER. Kimori, Fu (Kyushu Univ., Fukuoka); Takikuchi, Yosi;

Tanaka, Fumio; Turuga, Yasuhachiro. Rinsho to Kenkyu, 39: 1784-93(1962). (In Japanese).

A review (141 references) on clinical and experimental data relating to radiosensitivity of cervical carcinoma in humans with particular emphasis on concepts, sensitization response (SR), and radiation response (RR) as prognostic indices is presented. Evidence that illustrates the value of SR and RR in predicting recurrence of cancer is also presented. Methods that have been used for the evaluation of: tumor cell radiosensitivity, such as tissue culture and exfoliative cytology techniques; cellular degeneration of tumors, such as Feulgen and methyl green-pyronine staining to observe DNA and RNA contents in cells; metabolism and viability of tumor cells, such as tracer studies with labeled amino acids and purines; determination of SR and RR of tumors, such as buccal cells; enzyme activity of tumor cells as a reflection of tumor cell activity, such as activity of β-glucuronidase; and alteration and enhancement of tumor radiosensitivity, such as treatment with androgen-hormones and hyperbaric oxygen therapy, were discussed. (TSS)

34709 EFFECT OF PHLOGODYM (NEODYMIUM PYROCATECHOL DISULPHONATE) ON INFLAMMATION CAUSED BY BETA-RAYS IN THE RABBIT). Oyvin, I. A.; Uklonskaya, L. I.; Romanovskaya, L. I. (Inst. of Medical Radiology, Obninsk, USSR). Acta Physiol. Acad. Sci. Hung., 29: 91-4(1966).

Some earth metal complexes, in particular the compounds of neodymium, are known to have anticoagulant properties, and neodymium pyrocatechol disulfonate (Phlogodym) is not only an anticoagulant but also a powerful antiphlogistic agent. The effects of Phlogodym on inflammation caused by irradiation were studied in rabbits. A β source of $^{90}Sr-^{90}Y$ was applied to the upper third of the inner surface of the rabbit's ear for 4 hr and 20 min to give a dose of 14,000 rad. The rabbits of the experimental group received Phlogodym into the marginal ear vein, in doses of 35 mg/kg one hour before irradiation and then daily for four days after the irradiation. A radiometric method, using attenuation of β rays to measure thickness of the ear, was employed to evaluate the degree of inflammation. The increase in ear thickness in Phlogodym-treated rabbits was half of that observed in the controls. In the untreated rabbits radioinduced ear injury developed faster. The formation of an ulcer began on the fourth to sixth day. After 55 to 60 days the crust had separated from the skin and a hole appeared. In the rabbits treated with Phlogodym, formation of the skin ulcer was observed three days later, and its healing was noted 40 to 45 days after irradiation. The results indicate that Phlogodym significantly inhibits the development of the ear skin injury caused by β rays in rabbits. (TSS)

34710 CLINICAL AND EXPERIMENTAL RESEARCH ON THE BEHAVIOR OF THE TRI-n-OCTYL ESTER OF RADIOACTIVE PHOSPHORIC ACID ADMINISTERED BY INTRALYMPHATIC INFUSION IN A LIPID VEHICLE (LIPIODOL U. F. ^{32}P). Bresadola, S.; Cerutti, R.; Bevilacqua, L.; Marsiletti, G. C.; Pastina, R.; De Salvia, D. (Univ., Padua). Attual. Ostet. Ginecol., 11: 592-604(Sept.-Oct. 1965). (In Italian).

Blood, tissue, and urinary levels of radioactivity were determined in mammals. Rad doses in various tissues were estimated in mice, rats, dogs, and humans after administration of this radiotherapeutic agent by various routes. The tri-n-octyl ester of ^{32}P-phosphoric acid in Lipiodol with a sp act. of 76 μCi/ml was shown to be retained largely in the lymphatic system after intralymphatic injection, with little activity appearing in blood and urine. After intraperitoneal injection of 76 μCi in rats, the tissue levels (μCi/g) were: liver 0.019, spleen 0.052, kidney 0.019, and brain 0.0047. In dogs the tissue radiation doses were as follows after injection of 1 mCi ^{32}P in 6 ml Lipiodol into the pelvic lymphatic system: lymph nodes 2600, lung 595, spleen 21.4, liver 24, bile 60, bone marrow 4.6, kidney 4.3, pancreas 3.6, brain 1.6, and blood 1.6 Rad. In a patient with uterine cervical cancer 24 days after injection of 1 mCi into the pelvic lymphatics the estimated tissue doses were: ipsilateral lumboaortic lymph nodes 25,000, contralateral nodes 10,980, lung 390, pancreas 6, liver 4, kidney 3, spleen 2, muscle 1, and blood 1 Rad. Hence, a lymph node/blood Rad dose ratio ~25,000 can be obtained with this agent. Extensive additional data are provided on the distribution and excretion of this radiotherapeutic agent. (BBB)

34711 ASPIRIN AND ULTRAVIOLET LIGHT-INDUCED ERYTHEMA IN MAN. Miller, W. Stacy; Ruderman, Frank R.; Smith, J. Graham Jr. (Duke Univ., Durham, N. C.). Arch. Dermatol., 95: 357-8(Apr. 1967).

The interaction of aspirin with uv-induced erythema was studied using radiation in the 2900 to 3200 Å. A double-blind crossover study was conducted. Orally administered aspirin buffered with magnesium aluminum hydroxide significantly reduced uv induced erythema in the 10 adult male subjects tested when compared with magnesium aluminum hydroxide used as a placebo. This effect was most noticeable at 4 and 6 hr postirradiation but could be detected at 24 hr. Of the four subjects who complained of itching, aspirin relieved this symptom. The amount of aspirin taken (3.6 g per day) was within the usual therapeutic dose. The mechanism of this effect of aspirin is not known. A possible mechanism of action could be stabilizing lysosomes and the inhibition of kinins or enzymes. (BBB)

34712 INCREASE OF CERTAIN ENZYMES IN THE PLASMA OF THE RAT AFTER INJECTION OF A RADIOPROTECTIVE DOSE OF CYSTEAMINE. Plomteux, G.; Beaumariage, M. L.; Heushem, C.; Bacq, Z. M. (Univ., Liege). Arch. Int. Pharmacodyn., 163: 230-1(Sept. 1966). (In French).

Injection of radioprotective agents bearing SH or SS groups may cause, within a few minutes, marked metabolic changes (notably in the utilization of carbohydrates) and the appearance of severe injury (though reversible in 90 to 120 min) to mitochondria and endoplasmic reticulum, evident by electron microscopy. The passage of cellular enzymes into plasma verifies these cellular changes. Rats were injected intraperitoneally with 100-mg/kg doses of cysteamine, and the following enzymes were assayed in plasma 10 to 240 min later: glutamic-oxaloacetic transaminase (GOT), lactic dehydrogenase (LDH), malic dehydrogenase (MDH), glutamic dehydrogenase (GDH), and β-glucuronidase. The results showed that enzymes localized in cytoplasm (LDH), mitochondria (MDH, GOT), and lysosomes (β-glucuronidase) pass rapidly into plasma. GDH, which is present in mitochondria, showed no significant change in its plasma levels. GOT and LDH levels rose to a maximum of almost 4 times normal at 120 min. At the same period MDH reached a maximum of 7 times the normal level and β-glucuronidase about 2½ times normal. (BBB)

34713 GENETIC VARIATION AND ITS INFLUENCE ON PROTECTION BY L-CYSTEINE AGAINST GAMMA RADIATION. Mahmood, Noorul Hasan; Ifzal, S. M.; Islam, Fakhrul (Atomic Energy Center, Lahore). Pakistan J. Sci. Ind. Res., 8: 112-17 (July 1965).

Four closely related strains of Escherichia coli were used to determine whether or not probable genetic variations among closely related strains of the bacterium have some influence on the behavior of a population towards various bacteriocidal and bacteriostatic agents. In addition, special attention was given to the question of whether such a difference influenced the recovery of cells exposed to γ radiation in the presence of cysteine and whether or not the dose reduction factor was a constant factor for different bacteria and other cells. Results revealed that striking differences existed in sensitivity of the organism to γ radiation within the same species and under the same experimental conditions; i.e., the surviving fraction of the strains employed in the cysteine-γ radiation studies showed a range in protection ratio that was dependent on the strain chosen. Although there seemed to be a good correlation between inactivation by hydrogen peroxide and radiation sensitivity of the cell, a similar relation was also seen towards penicillin sensitivity of the individual strains. There seemed to be no relation between sensitivity to H_2O_2, penicillin, or radiation and the temperature sensitivity of Escherichia coli. Results are discussed in relation to mechanisms of protection and repair. (B.H.S.)

34714 PRESENT ORIENTATIONS OF RADIOTHERAPY WITH HEAVY PARTICLES. Pini, M. (Ospedale Civile Maggiore, Trieste, Italy); Taddeo, G.; Tomiselli, M.; Zacche, E. Radiaz. Alta Energ., 6: No. 1, 3-27(Jan. 1967). (In Italian).

A review of the present developments in heavy-particle radiotherapy is presented. The biological action and the oxygen effect are described. Techniques and results obtained with α particles are discussed. A large number of references are given. (J.S.R.)

34715 INFLUENCE OF THE X-RAY IRRADIATION ON THE ACTIVITY OF THE SERUM TRANSAMINASE IN RAT EXPERIMENTS. Sovenyi, Ervin; Thury, Geza; Tenyi, Maria. Magy. Radiol., 19: 158-62(June 1967). (In Hungarian).

It was found that the increase of the activity of the glutamic acid—oxalacetic acid transaminase in the liver tissue could be prevented by administration of cysteamine and serotonin before irradiation. The change of the activity in the serum and the fractions of beta-globulin failed to come about only in the case of administration of cysteamine; serotonin, on the other hand, did not influence the radioinduced alterations. It was obvious that the factors playing a role in the radioprotective effects of the cysteamine and the serotonin were different. (auth)

34716 DIAGNOSTIC EVALUATION OF 10 YEARS' MATERIAL OF PATIENTS WITH PULMONARY TUMOUR. Horvath, Jozsef; Kenez, Jozsef; Laszlo, Pal. Magy. Radiol., 19: 129-42(June 1967). (In Hungarian).

After the discussion of the etiologic role of the inhalation nuisances, the importance of the screening tests and obligatory examinations was pointed out, in order to assure early surgical intervention on patients suffering from pulmonary carcinoma. The routine examination methods are described, and the importance of the bronchography in the diagnosis of peripheral tumors was pointed out. Other diagnostic methods for pulmonary carcinoma, such as the use of isotopes, were discussed. The difficulties of differential diagnosis are reviewed, and the responsibility of the first examiner is emphasized. (auth)

34717 EARLY TUMOR LOCALIZATION IN THE SKELETON WITH ^{85}Sr. Hengst, Wolfgang; Ohe, Marianne v. d. (Krankenhauses Nordwest, Frankfurt am Main). Fortschr. Geb. Roentgenstr. Nuklearmed., 106: 728-33(May 1967). (In German).

The diagnostic significance of radioactive strontium in the search for bone metastases that cannot be shown by x rays is demonstrated on different clinical examples. The discussion extends to the problems that result from regions of re-formation of bone occurring with inflammatory, degenerate, or reparative processes whereby the differential diagnostic situation can usually be clarified from the clinical picture. The method suitable for larger hospitals is without hazard to the patient, causing no discomfort, and can be carried out on the outpatient. (tr-auth)

34718 EVALUATION OF ^{32}P FOR INTRACTABLE PAIN SECONDARY TO PROSTATIC CARCINOMA METASTASES. Joshi, Daya P.; Seery, William H.; Goldberg, Leo G.; Goldman, Leonard (Long Island Jewish Hospital, Jamaica, N. Y.). J. Amer. Med. Ass., 193: 621-3(Aug. 16, 1965).

Thirteen patients with intractable pain secondary to carcinoma of the prostate were treated with testosterone and ^{32}P with satisfactory results. The action of ^{32}P as related to perineural infiltration was investigated using microradiography. A regimen substituting estradiol benzoate for testosterone is also under investigation. (BBB)

34719 DRUMSTICK OF BLOOD CELLS AND BONE MARROW TRANSPLANTATION IN DOGS. Mikami, Chuji; Sato, Tsutomu (Hirosaki Univ., Japan). Igaku To Seibutsugaku, 71: 392-4 (Dec. 1965). (In Japanese).

Autologous bone marrow cells were transfused intravenously into adult mongrel dogs irradiated with lethal doses of x rays. Peripheral leucocytes were observed and the frequency of the appearance of drumstick-shaped cells was determined. The results showed that there was no significant difference before and after the bone marrow transfusion. (NSA of Japan)

34720 CHANGE OF OXYGEN TENSION AND REDOX POTENTIAL IN VARIOUS MOUSE ORGANS BY THE ACTION OF RADIOPROTECTORS. Dobrovol'skii, N. M. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Radiobiologiya, 7: 240-2(1967). (In Russian).

Radioprotectors investigated were amines (mexamine and serotonin), sulfur compounds (cystamine and AET), a methemoglobin former (sodium nitrite) and hypoxia. Mexamine and serotonin lowered the oxygen tension (p_{O_2}) in the spleen, kidney, muscle and testes by 40 to 70% and lowered the redox potential E_h. No changes of those values were observed in the liver and brain. Cystamine and AET did not substantially change p_{O_2} but lowered E_h in all the organs. Hypoxia caused a reduction of p_{O_2} in all the organs in proportion to the reduction of that value in the inspired air. The degree of reduction of E_h and the degree of tissue hypoxia correspond. In the action of amines, sodium nitrite and hypoxia the reduction of E_h depends on the oxygen deficiency created in the tissues. (JPRS)

34721 A POSSIBLE MECHANISM FOR THE RESTORATIVE ACTION OF ENDOTOXIN IN RADIATION SICKNESS. Uchitel, I. Ya.; Khasman, E. L. (Inst. of Epidemiology and Microbiology, Moscow). Radiobiologiya, 7: 221-8(1967). (In Russian).

Irradiated rabbits (650 to 700 R) were examined to investigate the extent incorporation of tagged elements into proteins. In the spleen, cerebrum, and lymphatic apparatus some increase of the extent of incorporation of tagged amino acid was observed at first, disappeared on the third day and returned by the end of the first week. The administration of endotoxin 1 to 3 days after irradiation especially stimulated that extent in the marrow, spleen, and lymphatic apparatus but not in the brain, but had practically no effect when administered two days before irradiation. This difference in the ability of endotoxin to restore antibody production is connected with its effect on the extent of incorporation of tagged amino acid into proteins. (JPRS)

34722 INFLUENCE OF SINESTROLE ON THE GLYCOGEN CONTENT OF THE SPLEEN NEUTROPHILS OF IRRADIATED MICE. Ogandzhanyan, E. E. (Ministry of Public Health, Erevan). Radiobiologiya, 7: 211-13(1967). (In Russian).

Sinestrole (0.1 ml of 2% oil solution) was administered seven days before irradiation. In the first two weeks after irradiation the test and control groups had the same changes in glycogen content (a sharp increase in 24 to 48 hours and then a steady decrease). On the 14 to 17th days the treated group had an increase of glycogen in the neutrophils to the initial values, mainly through an increase in the percentage of cells saturated with glycogen and reduction of the number of neutrophils containing no glycogen. Consequently sinestrole helps to normalize glycogen metabolism and evidently also phagocytic activity. (JPRS)

34723 CLINICAL EXPERIENCE WITH A WATER-SOLUBLE ADRENOCHROME DERIVATIVE (AC-17) IN THE PREVENTION OF RADIATION INJURY. Isome, S.; Tagaya, F.; Oka, H. (Tokyo Univ.). Agressologie, 6: 317-25(May-June 1965).

Adona, a water-soluble adrenochrome derivative, reduces the usual side-effects of x ray therapy. Adona is sodium 1-methyl-5-semicarbazon-6-oxo-2,3,4,6-tetrahydroindole 3-sulfonate, generically designated as carbozochrome sodium sulfonate. It possesses a powerful capillary strengthening and hemostatic action. It can be administered per os or by the intramuscular and intravenous routes; intravenously its action is rapid and it can be used in high doses. Adona was administered to 50 patients intravenously, in doses of 100 mg, concomitantly with radiation therapy every other day during the entire course of deep x-ray therapy following surgery of breast carcinoma. The irradiated skin was regularly examined; leukocyte counts and chest x rays were performed. When Adona was given during x-ray therapy, the incidence of skin injury in areas exposed to radiation was 13.1% vs 70% in the control group. In the Adona group, the pattern of decrease of leukocyte counts could be divided into 3 types, and the decline was less in the Adona group than in the control group. In the Adona group 18 out of 40 cases showed an initial decrease followed by an increase in leukocyte count during the course of radiotherapy. Pulmonary fibrosis occurred in some patients, particularly in the control group. With Adona the incidence of pulmonary lesions was reduced, and their degree minimized. (BBB)

34724 REDUCTION OF THE TOXICITY OF "RADIOMIMETIC" ALKYLATING AGENTS BY THIOL PRETREATMENT. VI. THE MECHANISM OF PROTECTION BY CYSTEINE. Ball, C. R.; Connors, T. A. (Royal Cancer Hospital, London). Biochem. Pharmacol., 16: 509-19(Mar. 1967).

The solid Yoshida sarcoma in rats was protected approximately twofold against the cytotoxicity of the alkylating agent melphalan if the animals were pretreated with cysteine. Using labeled melphalan it was shown that in cysteine pretreated rats the uptake of the alkylating agent by the tumor was not affected but that reaction with the nucleic acids and nuclear protein of the tumor was much reduced. In vitro experiments showed that cysteine prevented the reaction between melphalan and nucleic acids to the same extent as that occurring in vivo. A correlation was shown between the reactivity of thiols in vitro towards melphalan and the ability of thiols to protect whole animals. (auth)

34725 IS BUTAZOLIDINE A LIGHT PROTECTIVE AGENT? Burckhardt, W.; Dvchioni, P. (Staedtische Poliklinik fuer Hautkrankheiten, Zurich). Dermatologica, 133: 63-5(1966). (In German).

It required 4 to 6 times as long as normal to produce erythema by uv irradiation of 2500 Å from a Hg lamp when skin was pretreated with butazolidine salve. This wavelength corresponds to the physical absorption maximum of the salve. When skin was exposed to the entire range of uv wavelengths with an intervening butazolidine filter not in contact with the skin, there was no diminution of uv erythema by the butazolidine filter. Administration of 600 to 800 mg of butazolidine during 3 days had no effect on the uv sensitivity of the test persons. There appeared to be no pharmocodynamic effect of the drug. The only possible use butazolidine might have in this connection would be for erythema prevention by astronauts, where its effect would be entirely physical. (BBB)

34726 EXPERIMENTAL RADIOCARCINOGENESIS OF THE KIDNEY BY X RAYS IN THE RAT. II. RENAL RADIOLESIONS AND THEIR REPERCUSSIONS. Maldague, P. (Univ. Catholique, Louvain). Pathol. Eur., 2: 1-54(1967). (In French).

The renal lesions that precede and accompany radiocarcinogenesis in the kidney in the rat were observed at different levels of the nephron. There were vascular lesions (in endothelial cells of the malpighian tuft and the media of the afferent arterioles) and epithelial lesions (in convoluted tubules, loops of Henle, and col-

lecting tubules). These radiolesions led to renal atrophy and nephrosclerosis. At the same time it was possible to observe foci of epithelial regeneration which preceded the formation of adenoma or carcinoma. The proliferation of epithelial cells was stimulated by the factors which are responsible of the compensatory hypertrophy of the contralateral nonirradiated kidney. Doses of x rays equal to or lower than 570 rad did not produce renal lesions and were unable to induce radiocarcinogenesis in the kidney. Therefore, the threshold dose for radiosensitivity of renal tissue is between 570 and 850 rad, which is the same value as the threshold dose for renal radiocarcinogenesis. The renal lesions led to kidney atrophy, and long-term survival of the animals was accompanied by hypertrophy of the contralateral nonirradiated kidney. The animals survived until the appearance of cancer in the irradiated kidney. If the nonirradiated kidney was removed, the animals died rapidly of radiation nephritis, the general signs of which were high blood pressure, uremia, increased diuresis, proteinuria, and glucosuria. The renal hypertension which accompanied this radiation nephritis never appeared in the presence of the contralateral nonirradiated kidney. This kidney thus inhibited the hypertensive factors produced by the irradiated kidney. (BBB)

34727 EXPERIMENTAL RADIOCARCINOGENESIS OF THE KIDNEY BY X RAYS IN THE RAT. I. RADIATION CANCERS OF THE KIDNEY. Maldague, P. (Univ. Catholique, Louvain). Pathol. Eur., 1: 321-407(1966). (In French).

Total-body x irradiation was used to produce cancers that were a consequence of the local absorbed dose of radiation. The carcinogenesis in hormone-dependent organs such as prostate gland, seminal vesicles, mammary gland, ovaries, and adrenals could be obtained with relatively small doses of x rays: 325 to 625 rad. Higher doses in the range of 625 to 850 rad produced cancers in the digestive system: stomach, small bowel, colon, and salivary glands. Irradiation of the abdominal region increased the incidence of lymphoma in the ileocecal lymph nodes. Radiocancers of the kidney appeared after higher doses of x rays: 850 to 1000 rad. These cancers arose after a particularly long latent period, 15 to 20 months. Since total-body x irradiation produced a shortening of the life span, radiocancers of the kidney developed only in a few irradiated animals. Local kidney irradiation in situ allowed prevention of the shortening of the life span and much higher doses of x rays could be administered. Different doses of x rays were used for the determination of the relation between dose and carcinogenic effect for the kidney: 570, 855, 1140, 1710, 2850, 7125, and 14,250 rad. A study of the incidence of cancers as a function of the absorbed dose revealed the existence of a threshold dose for radiocarcinogenesis of the kidney; this theoretical dose was between 570 and 850 rad. The dose which produced the highest number of kidney cancers in the rats, or the optimal dose, was in the range of 1710 rad. Higher doses were much less effective and the dose of 14,250 rad did not produce any kidney cancers. The renal tumors produced by local irradiation of the kidney were of various histological types: basophil and acidophil adenoma and carcinoma, clear-cell adenoma and carcinoma, anaplastic carcinoma, diffuse sarcoma of the kidney, or sarcoma of the retroperitoneal tissue, sometimes with multiple or complex tumors in the same kidney. Cysteamine afforded some protection against the carcinogenic action of x rays in the kidney. (BBB)

34728 NEPHROGRAPHIC INVESTIGATIONS OF RENAL TUBERCULOSIS. Hennig, K.; Platzbecker, H.; Raatzsch, H. (Carl Gustav Carus Medizinische Akademie, Dresden). Radiol. Diagn., 8: 155-60(1967). (In German).

Studies were made on renal function with the help of isotope nephrography in 50 patients with confirmed urogenital tuberculosis in order to gain information on functional disturbances in individual stages of tuberculosis. According to our experience, even though it is not possible to differentiate between individual stages of tuberculosis with the help of isotope nephrography, the investigation does reveal the stenosing process of the ureter, a factor which decides the further fate of the kidney. (tr-auth)

34729 EXPERIENCES WITH COLLOIDAL ^{99m}Tc. Hennig, K. (Carl Gustav Carus Medizinische Akademie, Dresden); Woller, Peter; Knoll, Peter.

The preparation and use of technetium sulphide colloid is reported. Whereas in experiments on rabbits, along with liver, bone marrow could also be visualized clearly on scintigraphy, in man the bone marrow was visualized only when the liver was damaged. The unfavorable size of particles is considered as a reason. The liver scintigrams were of good quality in all cases. The radiation dose for the patient is very low. (tr-auth)

34730 NEPHROGRAPHY IN SMALL CHILDREN WITH ^{125}I-HIPPURAN. Loebe, J.; Gursky, S. (Karl-Marx-Univ., Leipzig). Radiol. Diagn., 8: 145-8(1967). (In German).

Comparative investigations with ^{125}I and ^{131}I showed that in small children, considering the conditions of absorption and radiation from the other side, a better delimitation of the course of activity in both kidneys is possible with ^{125}I-Hippuran than with ^{131}I-Hippuran. An optimal investigation technique adapted to anatomical conditions in small children is thus applicable without increasing the necessary test activity. The use of ^{125}I-Hippuran for isotope nephrography in children has, apart from a better investigation technique, further advantage of a smaller radiation dose than in case of ^{131}I-Hippuran. (tr-auth)

34731 THE URINARY MUCOPROTEIN IN RADIATION INJURIES. PART II. HORMONAL INFLUENCING OF URINARY MUCOPROTEIN IN EXPERIMENTAL RADIATION SYNDROME. D'Addabbo, Angelo; Viterbo, Francesco; Fanfani, Gilberto (Univ., Bari, Italy). Strahlentherapie, 133: 108-16(May 1967). (In German).

Whole-body irradiation of rats with lethal doses of x rays caused an increased urinary mucoprotein excretion. Treatments with several hormones produced the following effects: Administration of ACTH prior to radiation increased the resistance to radiation and considerably diminished the mucoprotein levels in urine. 5-HT had the same effect as ACTH with intact animals as well as with hypophysectomized rats. The protective function of a prolonged treatment before radiation with pineal extract clearly resulted in higher radioresistance and reduced mucoprotein excretion. The findings show that the amount of mucoprotein excretion, as the expression of the nonspecific mesenchyme response to stimulation, was indicative of the protective effect of the employed hormones against radiation injury. (auth)

34732 EFFECTS OF X-RAYS ON THE SECONDARY GILL FORMATION AND THE TAIL REGENERATION IN BRANCHIURA SOWERBYI. III. THE PROTECTIVE EFFECT OF CHLOROBUTHANOL AGAINST X-IRRADIATION ON TAIL REGENERATION IN BRANCHIURA SOWERBYI. Tanaka, Norimoto (Kyoto Prefecture Univ. of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 922-6(Oct. 1966). (In Japanese).

The highest degree of radiation protection,was observed in the crustacea Branchiura sowerbyi maintained in 20% chlorobutanol solution prior to and during x irradiation (6000 R). There was no difference in the volume of dissolved oxygen between water and 20% chlorobutanol solution as determined by polarography. The protective action of chlorobutanol is probably caused by the change of the oxygen content of the cells and considerably reduced oxygen consumption. However, other biological factors may be involved. (NSA of Japan)

34733 OPPORTUNITIES FOR USING ANTIBODIES AS CARRIERS OF NEUTRON-CAPTURING NUCLIDES IN NEUTRON-CAPTURE THERAPY. Skoropad, Yu. D.; Ryabukhin, Yu. S. Med. Radiol., 12: No. 6, 53-6(June 1967). (In Russian).

The practicability of employing antitumor and antifibrinogenic antibodies as carriers of neutron-capturing nuclides in neutron-capture therapy is assessed. The resultant calculations give evidence of the possibility to use these antibodies for delivering ^{235}U into the tumor seated at a depth of from 0 to 15 cm, with the multiplicity factor for the excess of the absorbed dose in the new growth over the maximum adsorbed one in normal tissues comprising 4. As regards the possibility of utilizing antitumor and antifibrinogenic antibodies as carriers of ^{6}Li and ^{10}B this, if any, exists only for tumors seated at limited depths. (auth)

34734 DOSIMETRIC DATA ON CRITICAL ORGANS DURING RADIOISOTOPE DIAGNOSIS OF BRAIN TUMORS. Ulitovskaia, I. I. Vopr. Psikhiat. Nevropatol., 11: 58-66(1965). (In Russian).

Hazards from radiation exposure to critical organs were assessed in humans and mice with brain tumors from Na^{131}I and ^{131}I-labeled diiodofluorescein (DIF) used as tracers for scanning. With these diagnostic methods, some effects on the thyroid can be expected with ^{131}I and on the gall bladder with ^{131}I-DIF. However, it is suggested that these do not constitute any immediate hazard to the patient, although long-term effects cannot be excluded even with the low doses used. It is estimated that with ^{131}I as a diagnostic agent there is a 100-fold margin of safety, but with ^{131}I-DIF only a 10-fold margin. Means whereby the tissue dose can be reduced in diagnostic methods employing radioisotopes are discussed. For example, blocking of the thyroid with stable iodide before administration of ^{131}I and the use of choleretic agents and purgatives with ^{131}I-DIF are recommended. This will reduce radiation exposure of critical organs appreciably. (BBB)

34735 RADIOPROTECTIVE EFFECT OF 3'NUCLEOTIDE UNDER RADIOTHERAPY. Hashi, M.; Tanaka, Y. (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 26: 432-6(Aug. 1966). (In Japanese).

The radioprotective effects of 3'Nucleotide (Nucleton) were

evaluated in 15 patients with breast cancer during therapy with supervoltage x radiation. The injection of 3'Nucleotide was started when the white blood cell count was decreased to about 3000/mm³. The course of radiotherapy was completed in the treated case while in 46 control cases the course of radiotherapy had to be interrupted in 18% of the cases due to radiation injury of the hematopoietic system. (NSA of Japan; TSS)

Radiation Effects on Animals

Refer also to abstracts 34589–34593, 34606–34610, 34612, 34623, 34632, 34634, 34661, 34670, 34687, 34688, 34708, 34732, and 34846.

34736 (AD–633620) CENTRAL NERVOUS SYSTEM RESPONSE TO LOW-LEVEL X-IRRADIATION. Final Report. Sams, Crawford F. (California Univ., San Francisco. Dept. of Neurology). Dec. 1965. Contract OCD-OS-62-148. 148p. CFSTI.

An electrophysiological response of the CNS of dogs manifested by high-voltage, erratic spiking and bilateral asynchrony was shown to exist following low-level head-only x-irradiation of 1 to 100 rad. Evidence obtained in a study of possible mechanisms involved is consistent with nerve cell membrane permeability changes. (auth)

34737 (AD–637688) SOME EFFECTS OF MIXED IONIZING RADIATIONS ON RHESUS PRIMATES EXPOSED UNDER LABORATORY CONDITIONS. Technical Report, January 1954–May 1964. Melville, G. S. Jr. (Texas Univ., Austin. Radiobiological Lab.). Contract AF 41(609)-2005. 34p. (SAM-TR-64-48). CFSTI.

The radiobiologist has been concerned with both the early and late effects of ionizing radiations administered in small increments over a relatively long period of time. In 1954, 48 Macaca mulatta primates were exposed to an irradiation schedule involving fast neutrons and gamma rays which resulted in the accumulation of doses from 77 to 614 Rep. Since the exposure schedules afforded rest and recovery periods, it was proposed and found that the effects were less severe than the effects from comparable doses given acutely. The principal early effect noted was a transient decrease in peripheral cell counts for leukocytes and erythrocytes noted in the higher dose group. The principal late effects involved a reduction in visual acuity in the 307- and 614-Rep groups; a series of definitive, continuing behavioral changes; and evidence of dose-dependent testicular damage as noted by histopathologic methods. Evaluation of the data suggests that radiation was probably not a factor in life-shortening. (CFSTI)

34738 (BNL–11510) CELLULAR RADIOBIOLOGY IN THE MAMMAL. Bond, V. P.; Robinson, C. V. (Brookhaven National Lab., Upton, N. Y.). May 22, 1967. Contract AT(30-2)-Gen-16. 27p. (CONF-670305-6). Dep. CFSTI.

From Symposium on Biological Interpretation of Dose from Acceleration Produced Radiation, Berkeley, Calif.

Extrapolation of radiation effects on the intact mammal from effects at the cellular level by means of the distribution of absorbed dose throughout the body, the distribution of cells of interest, and the dose-effect curves for these cells and the effects of interest is illustrated. Data are available for exact evaluation with respect to early effects. It was shown that the same approach may be applied more generally, and perhaps even with long term effects such as the development of malignancies. However, data are at present insufficient for adequate evaluation and the approaches still highly hypothetical. The paramount importance of obtaining more quantitative data, particularly dose-effect curves, especially at the cellular level, is stressed throughout. As more data of this nature become available, it will be increasingly possible to apply radiobiological principles in practical health protection. (H.G.D.)

34739 (COO–1270-1) PHYSIOLOGICAL STUDIES ON CONGENITAL DEFORMITY ANALYSIS OF ACTION OF RADIATION AND RADIOMIMETIC TREATMENTS. Technical Progress Report. Runner, Meredith N. (Colorado Univ., Boulder). Mar. 31, 1967. Contract AT(11-1)-1270. 19p. Dep. CFSTI.

A. The biochemical consequences of x irradiation during the period between treatment and observation of morphological damage were studied in chick embryos exposed to a dose of 800 R. Embryos were irradiated 36 to 38 hr after onset of incubation and the eggs were returned to the incubator for either 1.5 or 3 hr. before explantation of embryos to the surface of a liquid culture medium to which ^{3}H-thymidine was added. Embryos in explants were again returned to the incubator for a 30-min labeling period, after which the embryos were trimmed from their extra-embryonic membranes and pooled according to the developmental stage as determined by the number of somites. The total protein was determined by nephlerization and DNA was determined by the diphenylamine reaction after cold TCA extraction. The data show that depression in rate of synthesis of DNA is more pronounced than the decrease in the total DNA in the embryo, but whether this is a result of irradiation or handling was not determined. It is concluded that this method is applicable to studies of the effects of teratogenic treatment on whole embryos. Procedures are described for the microdetermination of proteins. B. Explanted chick embryos were used to study the mechanism by which thalidomide produces phocomelia. Preliminary treatment of embryos showed that soluble hydrolytic products of thalidomide produced edema, microcephaly, and limb bud defects within 48 hr of exposure. (C.H.)

34740 (N–67-11391) AEROSPACE MEDICINE AND BIOLOGY. A Continuing Bibliography With Indexes. (National Aeronautics and Space Administration, Washington, D. C.). Oct. 1966. 232p. (NASA-SP-7011(29)). CFSTI $3.00 cy, $0.65 mn.

A continuing bibliography related to the physiological, psychological, and environmental effects of interplanetary space and the earth's atmosphere on man is presented. References describing similar effects on biological organisms of lower order are also included. The material contains such topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors. In general, emphasis is placed on applied research, however, fundamental studies and theoretical principles are included. (STAR)

34741 (UCRL-16854) THE EFFECTS OF HOMOGENEOUS MAGNETIC FIELDS, AMBIENT GAS COMPOSITION, AND TEMPERATURE ON DEVELOPMENT OF TRIBOLIUM CONFUSUM. Amer, Nabil M. (California Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1965. Contract W-7405-eng-48. 65p. Dep. CFSTI.

Thesis.

Interaction between homogeneous magnetic fields and the kinetics of development and differentiation of the pupae of Tribolium was established. The interaction led to alteration in the normal developmental path. The degree and type of alteration were functions of the combination of chemical and physical parameters applied to the system. Essentially, magnetic fields had two basic effects: one was equivalent to cooling, and the other was the enhancement of the interaction with ambient oxygen, possibly through influencing the rates of oxidation. The data obtained from Tribolium, as well as from more recent preliminary findings with liquid crystals of cholesteric compounds, substantiated the hypothesis. (auth)

34742 (USNRDL-TRC–46) ANALYSIS OF JAPANESE NUCLEAR CASUALTY DATA. Final Report. Davis, L. Wayne; Baker, William L.; Summers, Donald L. (Dikewood Corp., Albuquerque, N. Mex.). Apr. 1966. Contracts OCD-PS-64-196; N228-(62479)69778. 326p. (DC-FR-1054).

This report summarizes the results of a detailed data reduction and casualty study made on over 35,000 persons who were subjected to the nuclear attacks on Hiroshima and Nagasaki, Japan, in 1945. Both graphical and tabular presentations are made of pertinent data to show that an excellent base exists for more reliable conclusions of a wider variety than have heretofore been available. Total mortality and total injury curves are given as well as injury curves by type (blast, thermal, and initial nuclear) for thirteen shielding categories, which includes a breakdown of seismic reinforced-concrete buildings by floor divisions. Further breakdowns of the blast and thermal injuries are also given here, but considerably greater detail will be presented in a follow-on effort directed towards predicting the medical load following a high-yield nuclear attack on the United States. The free-field weapons effects are presented for both Japanese cities to allow the association of a given effects level with a particular percent mortality or injury. Such comparisons indicate that the initial nuclear radiation played a dominant role in the deaths of thermally shielded people in both cities. Other post-attack data are given for those persons killed immediately, those rescued by others, those who survived in the fire, and the time of death of those who were killed. Numerous other investigations could be made on the vast storehouse of information that has been collected on magnetic tape during the course of this project. (auth)

34743 (N–67-15553) CHANGES IN THE PERIPHERAL DIVISION OF THE AUDITORY ANALYZER IN ACUTE RADIATION SICKNESS. Kozlov, M. Ya. Translated from Vestn. Otorino-Laringol., 20: No. 2, 29-35(1958). 14p. (NASA-TT-F-10361). CFSTI.

The function of the peripheral section of the auditory analyzer in guinea pigs was estimated with the aid of leads and recording of bioelectricity of the cochlea. In the first group of experiments (10 animals), quantitative evaluation of hearing was carried out. The second group underwent whole-body x-irradiation with the

dose of 350 R; subsequently, at the height of radiation sickness hearing was evaluated by the same method as above. The ability to hear decreased, on the average, from 3.9 to 9.1 dB. (STAR)

34744 (N-67-15700) THE "BIOSPUTNIK" IS CONDUCTING INVESTIGATIONS. Gurovskiy, N. Translated from Aviats, Kosmonavt., 48: No. 5, 32-4(1966). 8p. (NASA-TT-F-10650). CFSTI.

A general discussion is presented of the medical and biological investigation of the regions of intense radiation in the inner radiation belt (180 to 320 km altitude) of the earth. Developments are outlined in view of the launching of the biological satellite Cosmos 110, which has an orbit higher than any manned spacecraft and is intended for a prolonged stay in zones of increased radiation. Discussed in particular are the care of dogs aboard the satellite, the effects of cosmic radiation, solar flares, weightlessness, radiation protection, and the life support system for animals aboard the spacecraft. (STAR)

34745 X RADIATION INFLUENCE ON ACOUSTIC CAPSULE INDUCTION IN FROG EMBRYO. Popov, V. V.; Al'-Sakini, Khasan (Moscow State Univ.). Radiobiologiya, 6: 633-4(1966). (In Russian).

The formative stage relationship between the acoustic vesicle and surrounding mesenchyme was investigated. The influence of x radiation on the acoustic capsule was evaluated using 20 Rana esculenta embryos in the mean tail bud stage. The embryos were irradiated with 100 kV, 30μ current, with 300 R/min at a focusing distance of 10 cm. The results obtained showed that irradiation of the embryo, without surgical interference, did not inhibit the development of the acoustic vesicle or the induction of the acoustical capsule; however, after exposure to the 80 and 110 R doses the acoustic capsule was slightly thinner than in control embryo. Transplantation of such an acoustic vesicle to a normal host resulted in induction of an acoustic capsule that reached normal differentiation only along the vesicle part. The acoustic capsule transplanted from a normal to an irradiated embryo never developed, even in embryos irradiated with only 50 R. An analysis was made of the conditions and environment of acoustic capsule development. (R.V.J.)

34746 REACTION OF RED BLOOD CELLS IN X-IRRADIATED HENS, EXPOSED TO 600-R DOSES TWICE WITHIN 17 DAYS FOLLOWING OXYTETRACYCLINE, VITAMIN B_{12}, AND FOLIC ACID ADMINISTRATION. Surynek, J.; Mach, P. (Veterinary Coll., Brno). Sb. Vys. Sk. Zemed. Brne. Rada B, 11: 253-61 (1963). (In Czech).

The quantitative changes in hematocrits, hemoglobin content, and numbers of erythrocytes and platelets observed in 40 Leghorn hens irradiated with 600 R of whole-body irradiation twice, with a 17-day interval between irradiations, were similar to those observed in irradiated mammals. The hens were irradiated with 180-kV x ray, administered at a rate of 15 R/min. There was no statistically detectable effect on the results when 0.7 mg/Kg of oxytetracycline was given orally before and after irradiation. Treatment with folic acid (14 μg/Kg orally) or vitamin B_{12} (1.4 μg intramuscularly) was also ineffective. Generally, the effects of the irradiations on the red blood cell picture were greater in the hens treated with the drugs, but none of the values obtained were statistically different. Only a few values, such as the erythrocyte count and the total hemoglobin were at the borderline of statistical significance. (BBB)

34747 THE EFFECT OF X RAYS ON DEMOGRAPHIC CHARACTERISTICS OF A FRESHWATER GASTROPOD, PHYSA ACUTA DRAP. Ravera, O. (EURATOM, Ispra, Italy). Malacologia, 5: 51(Dec. 1966).

The effects of x radiation on the demographic characteristics of P. acuta were determined by measuring the rates of adult mortality, fecundity and fertility, and percentage of egg viability. The adults were irradiated in an unfiltered beam (300 KV, 10 mA) with total doses ranging between 2000 and 220,000 R. The dose rate ranged between 1000 and 2000 R/min. The mortality of the animals irradiated with 10,000 R was very similar to that of the controls; with 54,000 R, the mortality did not become significantly different from that of the controls until 20 days after irradiation; with 100,000 R, the mortality on the 18th day had increased to 95%; with 220,000 R all the animals died in one day. Up to a dose of 10,000 R the fecundity of the irradiated animals was moderately reduced. The effects of radiation on the number of eggs per capsule and on the production of capsules were also studied. A dose of 2000 R reduced both viability and fertility. An evident recovery of the germ tissues of individuals irradiated with 2000 and 10,000 R was observed. The role played by the interaction of temperature and radiation had more effect on the reproductive processes than on the survival of the adults. (BBB)

34748 ELECTROMAGNETIC AND SONIC ENERGY FOR INSECT CONTROL. Nelson, S. O. (Univ. of Nebraska, Lincoln). Trans. ASAE (Amer. Soc. Agr. Eng.), 9: 398-403;405 (1966).

Past accomplishments, current studies, and future possibilities for insect control using electromagnetic, sonic, and ultrasonic energy are reviewed. References (134) are included. (B.H.S.)

34749 VARIATION IN MITOTIC ACTIVITY IN EXTREMITY TISSUES OF AXOLOTL IN THE CASE OF RESTORED REGENERATION ABILITY INHIBITED BY X-RAY TREATMENT. Tuchkova, S. Ya. (Inst. of Animal Morphology, Moscow). Dokl. Akad. Nauk SSSR, 172: 222-4(Jan. 1, 1967). (In Russian).

It has been established previously that the x radioinduced inhibition of the regenerative ability of the tissues of the axolotl's limbs may be restored by the administration of a biopreparation, such as polymerized RNA. In order to determine the laws governing the recovery process, the mitotic activity of these tissues was studied after recovery and after irradiation. The 60 animals were divided in 3 groups, subjected to: amputation of the unirradiated limbs; irradiation of the limbs, followed by amputation; and irradiation of the limbs, treatment of the animals with DNA, and amputation. During the irradiation of the hind limbs at a total dose of 8000 R, the body of the animal was protected by a 4-mm thick lead shield. The number of mitotically active cells in the epithelial and subepithelial tissues in the regenerated organs was determined; the results indicated that the single local irradiation at 8000 R lowered considerably the mitotic activity of the exposed cells and caused the appearance of an atypical form of mitosis. (TTT)

34750 REACTION OF WHITE BLOOD CELLS IN COCKRELS IRRADIATED TWICE WITH 600 R OF X RAY AFTER TREATMENT WITH OXYTETRACYCLINE, VITAMIN B_{12}, AND FOLIC ACID. Surynek, Jaroslav; Mach, Petr (Veterinary Coll., Brno). Sb. Vys. Sk. Zemed. Brne. Rada B, 12: 429-38(1964). (In Czech).

The daily administration of 0.7 mg/Kg of oxytetracycline, 1.4 μ/Kg of vitamin B_{12}, or 14.0 μg/Kg of folic acid to cockrels that were exposed to two doses of 600 R of whole-body x irradiation at an interval of 17 days apart did not alter the white blood cell picture significantly. The drugs were given either before or after exposure to the radiation that was administered at a rate of 15 R/min. There was no statistical difference between the mortality observed in the treated and control animal groups. The changes observed in numbers of heterophilic cells, leukocytes, and lymphocytes were similar to those observed in mammalian blood after similar doses of x radiation. (BBB)

34751 MEDICAL IMPLICATIONS OF RADIOACTIVE FALLOUT. Dunham, C. L. (Atomic Energy Commission, Washington, D. C.). Triangle, Sandoz J. Med. Sci., 7: 44-8(1965).

The levels of fallout radionuclides in the biosphere, exposure of the population, and an estimation of possible effects and the risk involved are reviewed. Up to the end of 1962, atomic weapons, with 511 Mt of TNT explosive equivalent, detonated in the air or on the surface of the earth, released to the environment ~2×10^7 Ci of ^{90}Sr. It was suggested that a single dose of one rad to each individual in an entire population was not going to increase the incidence of leukemia by more than one or two cases per million per yr in the following 15 yr period. That is, the individual's chances of having leukemia as a result of such an exposure would not be more than one in 66,000. Exposures to fallout from nuclear weapons tests were, for the most part, at peak dose rates of less than 1 rad per day. Notable exceptions were the Rongelap Islanders, and the crew of a Japanese fishing boat, who received relatively high doses. There were also a few persons living in the vicinity of the Nevada Test Site who received a few rads exposure in one day. Compared to the estimated effects of natural environmental radioactivity, the added risks from fallout were considered to be small. Even in Alaska and Lapland, where the total dose that will eventually be received by the population from atmospheric testing may reach perhaps 3 rad, the dose received will not add substantially either to the overall genetic burden of the groups in question or to the natural risk of developing leukemia or bone cancer. (BBB)

34752 EVIDENCE FOR CYCLIC FLUCTUATIONS IN RADIOSENSITIVITY AND THEIR IMPLICATIONS. Kallman, Robert F. (Stanford Univ., Palo Alto, Calif.). Nat. Cancer Inst. Monogr., No. 24, 205-23(Feb. 1967).

Fractionated radiotherapy of tumors is discussed, including: elucidation of the mechanism of cell-killing by radiations (present understanding depends almost entirely upon accurate knowledge of survival parameters, viz., the D_0 or slope, and the extrapolation number, n); accurate definition of the kinetics of recuperation from sublethal injury, both in cells and in organized tissues; and knowledge of lethal susceptibility or radiosensitivity of cells in different stages of the cell cycle, plus knowledge of the extent of other ef-

fects, i.e., sublethal or reversible effects, as well as potentially lethal lesions, also as a function of stage cycle. Present information about the survival curve of anoxic mammalian cells is considered, particularly whether cells that are anoxic at the time of irradiation recuperate in the same manner as cells irradiated in the presence of oxygen. Experiments are described in which large numbers of inbred mice were given different first, or conditioning, x-ray doses. At different times thereafter, radiosensitivity was measured by determination of the size of the second dose required to give 50% lethality, i.e., the LD_{50}. From such data, it was possible to calculate the amount of residual injury at a given postconditioning time and plot the curve of recuperation. These experiments demonstrated a cyclicity during the first 2 days after conditioning irradiation. It was believed that this cyclic fluctuation of radiosensitivity was an expression of synchronization of the relevant or critical stem cell population, which was induced by conditioning irradiation. The cyclic period from the whole-body lethality experiments, namely, 8 hr, is evidence for the length of the cell cycle of the kind of cell which is primarily responsible for the acute lethal effect. For the range of doses employed, the relevant cell was the hematopoietic stem cell in the bone marrow, which has a generation time of ~10 hr. The cyclic period, then, was regarded as the generation time of bone marrow stem cells which exhibit but one resistant phase in the cell cycle, or alternatively, half the generation time of a stem cell having 2 resistant peaks in its cell cycle. (BBB)

34753 SUNLIGHT AND SKIN. Honeycutt, W. Mage; Dillaha, Calvin J.; Jansen, G. Thomas (Univ. of Arkansas, Little Rock). J. Arkansas Med. Soc., 60: 420-2(Apr. 1964).

Effects of uv light on skin are reviewed. Ultraviolet energy of wavelength 296 mμ produces the greatest erythema response in the shortest period of time, and wavelengths shorter and longer have less effect in producing erythema. The exact mechanism whereby uv produces erythema of the skin is not known. About 95% of the energy is absorbed in the stratum corneum and stratum malpighii, a depth of about 0.1 mm, leaving only 5% to penetrate to the dermis. Two principal theories regarding the mechanism of erythema production have been proposed: ultraviolet light is absorbed in the prickle cell layer, causing a photochemical reaction, with production of a vasodilating chemical substance which diffuses down to the dermis causing vasodilatation of the superficial vessels; and the uv penetrating to the dermis produces a direct toxic effect on the blood vessels, causing vasodilatation. Neither of these hypotheses has been substantiated. The darkening of the skin following exposure to 340 mμ irradiation is due to oxidation of premelanin (colorless) to melanin, is almost immediate in onset, and may last as long as a year. Pigmentation as a response to injury to the skin by uv is not the only mechanism of protection; the stratum corneum thickens after uv irradiation and this may be a major portion of the protective response, nearly on a par with pigmentation. Some systemic effects of uv are unexplained, such as the fall in blood pressure and decrease in serum cholesterol after irradiation. (BBB)

34754 STUDIES ON RECOVERY PROCESSES IN MOUSE L CELLS. Whitmore, G. F.; Gulyas, S. (Ontario Cancer Inst., Toronto). Nat. Cancer Inst. Monogr., No. 24, 141-56(Feb. 1967).

Results of experiments with tissue cultures are reported which indicate that in addition to any nonrepairable lesions produced by ionizing radiations there are lesions produced that have the potential of becoming lethal, and lesions that have the potential of being repaired. The existence of such a lesion was suggested by the finding that postirradiation treatment can influence survival levels. These experiments did not answer the question whether there is in addition a type of sublethal lesion requiring the addition of more irradiation to become lethal. Results obtained with split-dose or fractionation experiments indicate the existence of lesions of either one or both types. Whether the split-dose experiments and post-irradiation-treatment experiments are actually measuring the same type of lesion is considered. Since cells kept in phenethyl alcohol or at low temperatures prior to irradiation showed little or no recovery in a two-dose experiment, but did show protection in a single-dose experiment, the dose-fractionation and posttreatment experiments may measure the same type of damage. In split-dose experiments the over-all shape of the recovery curve is the result of at least 3 processes: progression, damage fixation, and repair. Some type of repair processes could be initiated at low temperatures and in the presence of substances which inhibit DNA synthesis. (BBB)

34755 OBSERVATIONS ON THE MIGRATION CAPACITY IN MICE OF NEOASCARIS VITULORUM LARVAE HATCHED FROM EMBRYONATED EGGS SUBJECTED TO 100,000 R FROM ^{60}Co. Casarosa, L.; Favati, V. (Univ., Pisa, Italy). Ann. Fac. Med. Vet., Univ. Pisa, 17: 67-74(1964). (In Italian).

The ability of irradiated larvae to parasitize mice was studied. In vitro embryonated eggs were obtained from female worms taken from the intestine of sheep and were irradiated with a total of 100,000 R of ^{60}Co γ radiation, in 3 successive irradiations. Mice were infected orally with 500 of the irradiated or nonirradiated embryonated eggs and then sacrificed 4 to 12 days later for examination of the distribution of the larvae. The lungs, liver, and kidney were digested with pepsin and the number of larvae counted in each organ. In all organs fewer larvae were found in the irradiated-larvae group than in the control group. Thus in the liver, where in both groups maximum numbers of larvae were found on the 6th day postinfestation, 80% of the administered control larvae were in the liver compared to only 10% of the irradiated larvae. In lung, where the peak numbers occurred on the 8th day, 20% of the nonirradiated larvae were found in contrast to only 5% of the irradiated ones. In kidney, no irradiated larvae were found at any time, compared with 8% of the control larvae. It is evident that 100,000-R irradiated larvae are drastically curtailed in their parasitizing ability. (BBB)

34756 BASIC MODEL OF TARGET THEORY FOR THE PROBABILITY P OF A CELLULAR (LETHAL) RESPONSE TO A DOSE D (OF RADIATION) AND ITS EXTENSION TO DOSE FRACTIONATION. Wette, Reimut (Univ. of Texas, Houston). Nat. Cancer Inst. Monogr., No. 24, 243-7(Feb. 1967).

A mathematical model is presented for use in expressing tumor cell radiosensitivity. Applications in studies on the effects of dose fractionation on lethal response are described. (BBB)

34757 MIDGUT EPITHELIUM OF ADULT CHELISOCHES MORIO (DERMAPTERA: CHELISOCHIDAE) AND CERATITIS CAPITATA (DIPTERA: TEPHRITIDAE) FOLLOWING IONIZING IRRADIATION. Little, H. F. (Univ. of Hawaii, Hilo). Ann. Entomol. Soc. Amer., 60: 412-14(Mar. 1967).

Two possible explanations for the radioresistance of adult insects are considered: dividing insect cells are as radiosensitive as are those of mammals, but adult insects have little dependence on dividing cells; or cells of adult insects can divide in spite of large doses of radiation. Evidence that the second explanation applies to two insect species is presented. The midgut epithelia of the earwig, Chelisoches morio, and of the Mediterranean fruit fly, Ceratitis capitata, were normal in appearance following exposure to 10,000 R of x rays and 10,000 rad of γ rays, respectively. The phenomenon was in contrast to the severe damage to mammalian small intestine that results from a dose only $\frac{1}{10}$ as great. Since there is good reason to believe that mitosis is important in maintenance of the midgut epithelium in both insect species, the radioresistance of the epithelium implies considerable radioresistance on the part of the regenerative cells. Destruction of gut epithelium by 100,000 rad demonstrated that the tissue could be disrupted by ionizing radiation and that failure of 10,000 R to produce any marked effect was not due to insusceptibility of the cells. The finding that the hindgut epithelium showed no obvious change even after 100,000 rad suggested that the observed destruction of the midgut epithelium was selective and should not be included in destruction of tissues in general. (BBB)

34758 RADIATION INJURY OF THE SKIN AFTER WORK WITH RADIONUCLIDES: A CASUISTIC CONTRIBUTION. Grundner, Han-Georg; Rausch, Ludwig (Wilhelm-Conrad-Roentgen-Klinik, Giessen, Ger.). Hautarzt, 16: 523-4(Nov. 1965). (In German).

The author describes several cases of skin damage produced by prolonged exposure to irradiation from x rays or β and γ emitters. In two cases pronounced damage to the whorl pattern of the fingers was observed 60 and 105 days after exposure to a single dose of 2000 R of 30 KV x ray. In a third case destruction of finger whorls was observed after 2 yr of exposure to an open soft β source, consisting of ^{35}S. The atrophy consisted of spotty flattening and diminution of the whorls and was more or less marked on all of the fingers. When the necessary protective measures were taken, recovery occurred within 3 months. More serious injuries were observed in a chemist employed in the production and testing of medical and industrial Ra sources. As indicated by film badge records it was estimated that the patient received 100 R over a period of 10 yr. The exposure to the hands for this time interval was estimated to be ~10,000 R. Whole-body measurements of this patient indicated a Ra incorporation 3 to 4 times the max permissible level. Hyperkeratoses, cornification, skin atrophy, and ulcerations appeared on the forefingers of each hand and on the right thumb. There was histological evidence of spinocellular carcinoma. Atrophy of the whorl patterns was detected on several other fingers. (BBB)

34759 RECOVERY FROM RADIATION INJURY IN SWINE AS EVALUATED BY THE SPLIT-DOSE TECHNIQUE. Nachtwey,

D. S.; Ainsworth, E. J.; Leong, G. F. (Naval Radiological Defense Lab., San Francisco). Radiat. Res., 31: 353-67(July 1967).

With 1-MVp x rays, the acute $LD_{50(30)}$ (midline air exposure) of 8- to 9-month-old Duroc gilts was determined to be 399 R (95% confidence interval: 371 to 424 R). The pattern of recovery from the effects of 240 or 265 R of x rays was studied by means of the split-dose technique, which consists in conditioning the animals with a sublethal exposure and redetermining the LD_{50} at various times thereafter. By this criterion, the swine had recovered from 51% of the initial injury by 3 days. By 7 days, they appeared to have recovered from about 65% of the initial injury, but the data indicate a considerable heterogeneity of response at this time. By 20 days, the entire population appeared to be radioresistant: the redetermined LD_{50} was 164% of the LD_{50} of unconditioned animals. Radioresistance was also evident at 61 and 107 days: at 61 days, 734 R killed 8 out of 15 animals conditioned with 265 R, whereas the same exposure killed 15 of 15 unconditioned animals; at 107 days, none of 9 conditioned animals died after 399 R. The pattern of systemic recovery and the period of radioresistance are not clearly reflected in the pattern of hematological changes that follow a conditioning exposure. (auth)

34760 A CYTOLOGICAL STUDY OF RADIATION EFFECTS ON TESTES OF THE SCREW-WORM FLY, COCHLIOMYIA HOMINIVORAX (DIPTERA: CALLIPHORIDAE). Riemann, John G. (Dept. of Agriculture, Fargo, N. D.). Ann. Entomol. Soc. Amer., 60: 308-20(Mar. 1967).

When pupae were γ irradiated, wide differences were found in the radiosensitivity of different cell types in testes of screw-worm. Almost all very young primary spermatocytes were apparently killed after a 100-R dose. Most secondary spermatogonia were killed with 500 R, and total destruction of the primary spermatogonia in different testes occurred over a range of 1500 to 3000 R. In testes irradiated with 6000 R, necrosis of most young spermatocytes and of all but a few early secondary spermatogonia was evident at 6 to 7 hr. Until the eighth hr, most primary spermatogonia did not show evidence of necrosis and some non-degenerate cells of this class were still seen at 12 hr but not at 24 hr. Death of all cells apparently occurred during interphase or perhaps very early prophase. Even at the highest dose level (6200 R), secondary spermatocytes and primary spermatocytes that had reached a certain stage of development were not killed. However, they did suffer gross chromosomal damage, and most of the spermatids formed from them failed to develop into normal appearing sperm. No morphological changes were observed in cells irradiated as spermatids or as immature sperm, and they developed into normal appearing mature sperm. The stages in the recovery of spermiogenic activity were traced out in flies that had received 1500 R as 2-day-old pupae. (BBB)

34761 RADIATION AND WHOLE LIGHT EFFECTS ON MOLLUSCAN NERVE CELLS IN VITRO. Sato, Makoto; Austin, George; Yai, Hideko (Univ. of Oregon, Portland). Radiat. Res., 31: 452-66(July 1967). (RLO-1371-1).

Acute effects of low-dose x radiation and light illumination on the isolated ganglion cells of Aplysia were analyzed by means of intracellular recording of their synaptic activities. The acetylcholine (ACh)-induced depolarization associated with an increase in membrane conductance was not significantly affected by x radiation up to 9300 R. Orthodromically activated excitatory postsynaptic potentials (EPSP's) were not markedly altered by x ray up to 4500 R, but they were slightly enhanced with the higher dose. The threshold firing level of the soma was not affected by a total dose of 13,000 R. Membrane resting potential (MRP) was hyperpolarized 1 to 3 mV during exposure to 1700 to 5000 R but was depolarized 1 to 3 mV during exposure to more than 13,000 R. It was concluded that the central nervous system of Aplysia is much more radioresistant than that of mammals. Light illumination produces either an increase or a decrease in frequency of the spontaneous spike discharge. It was found that the light does not alter the ACh-induced responses of either D- or H-membrane but it depresses the spontaneous EPSP's and IPSP's, indicating the suppression of the presynaptic activities. The threshold firing level of the D-type cells was markedly elevated during illumination. It is suggested that the primary cause of the light-induced change in synaptic activity is the elevation of threshold firing level of the spike at the presynaptic fibers. (auth)

34762 X-IRRADIATION OF DEFINED AREAS OF THE HEADS OF WEANLING RATS: EFFECT ON BODY GROWTH AND INCISOR DEVELOPMENT. Wachtel, Louis W.; Cole, Leonard J.; Bailey, James S. (Naval Radiological Defense Lab., San Francisco, Calif.). Radiat. Res., 31: 430-40(July 1967).

Weanling rats whose bodies were lead-shielded were x irradiated to defined areas of the head. Body growth, incisal tooth development, and histopathology of the tongue and glossopharyngeal area (throat) were studied for a period of 7 weeks following irradiation. An x ray dose of 2000 rads to the head and throat caused injury to the tongue and palate which resulted in a reduction in food intake and a marked loss in weight of the exposed rats. The more extensive the head area irradiated, the higher was the mortality, 100% deaths being attained at 9 to 10 days when the entire head was irradiated. Irradiation of the throat only with 2000 rads elicited 50% deaths. There was a persistent reduction in the growth rate of the survivors compared to that of nonirradiated controls. These effects were not seen if the base of the tongue only was irradiated. The maxillary incisors, which received 120 rads through the lead shielding, after 5 to 7 weeks were either lost or grew abnormally in all throat-irradiated rats. The same dose of x radiation to the maxillary incisors of rats in which the base of the tongue only was irradiated had no deleterious effect on their development. Lead shielding of the lower jaws prevented the loss of mandibular incisors. The possibility of a relationship between metabolic disturbances caused by throat irradiation and growth of the incisors receiving low doses of x radiation is postulated and discussed. (auth)

34763 EFFECT OF GAMMA RADIATION ON THE PREPUBERAL BOVINE OVARY. Erickson, B. H. (Univ. of Tennessee, Oak Ridge). Contract AT-40-1-GEN-242. Radiat. Res., 31: 441-51(July 1967).

Ninety-five Hereford calves were exposed to either whole-body (dose range 200 to 400 R, ^{60}Co, 0.7 R/min) or localized (dose range 300 to 1200 R, ^{137}Cs, 75 R/min) doses of γ radiation. Forty-three animals served as controls. Ovaries were excised either surgically or at sacrifice at postirradiation intervals of 30 to 700 days and analyzed microscopically for radiation effects. At 30 to 150 days postirradiation, doses of 600 R or less (local or whole-body) resulted in minor increases in atresia of primordial follicles and elevated numbers of growing and vesicular follicles. The superfollicular response was generally heightened with increasing dose. Follicular quality, however, declined as follicular quantity increased. At 700 days after the 200 R whole-body exposure, 98% of the primordial follicles (versus 78% for controls) showed degenerative changes, and evidence of the superfollicular response was lost. Suppression of follicular growth was severe following 900 R and was all but complete with 1200 R. Primordial follicle survival after 900 R was 42% of control, and 17% survived 1200 R to 500 days postirradiation. Following exposures of 300 R or greater, all but 4 of 12 animals developed to 500 days postirradiation experienced first estrus within expected age limits. Corpora lutea present at slaughter were, in all cases, abnormal. (auth)

34764 HISTOLOGIC EFFECTS OF TOTAL-BODY X-IRRADIATION IN VARIOUS DOSE FRACTIONATION PATTERNS ON FETAL CEREBRAL HEMISPHERE. Brizzee, K. R.; Jacobs, L. A.; Bench, C. J. (Univ. of Utah, Salt Lake City). Contract AT(11-1)-1474. Radiat. Res., 31: 415-29(July 1967). (TID-23672).

Albino rats of the Sprague–Dawley strain were exposed to 150 R of whole-body x irradiation on gestation days 13.5 and 14.0 in single doses and in several dose fractionation patterns within the 12-hour period. Residual tissue damage in olfactory bulbs, parolfactory areas, striatum, and primordial ependymal and cortical layers on gestation day 19.5 was heaviest in single-dose rats and decreased progressively in rats that received two 75-R exposures at 1-, 3-, 6-, 9-, or 12-hour intervals. No significant difference in effect was observed in animals receiving a single exposure on day 13.5 or on day 14.0. The severity of histological damage also decreased progressively in animals that received the total 150-R dose in 2, 3, 5, or 9 equal fractions over the 12-hour period and was less in the multiple-fraction animals than in the variable-interval group. It is concluded that size of the individual fractions is more important than the number of fractions at a specific total dose level over a given time period in determining severity of residual histological alterations resulting from dose fractionation regimens, and that residual tissue damage decreases progressively with increasing interval between two dose fractions from 1 to 12 hours. (auth)

34765 SILVER UPTAKE IN BRAINS OF CHRONICALLY GAMMA-IRRADIATED RATS: A STUDY BY NEUTRON ACTIVATION ANALYSIS. Scott, Walter L. Jr. (Texas A and M Univ., College Station). Radiat. Res., 31: 522-8(July 1967).

Albino rats were administered solutions of silver nitrate for an extended period and exposed for 90 days to ^{60}Co γ irradiation (20 R, 10 R, 5 R, or 2 R per day, and nonirradiated controls). Examination of the brains of these animals by neutron activation analysis disclosed the presence of silver. However, differences of silver concentration in brain tissues of the various groups did not reflect an irradiation influence on brain-silver concentration. This was corroborated by electron microscopic evidence. Under the conditions of this experiment the silver exclusion phenomenon of the blood-brain barrier remained intact. (auth)

34766 IRRADIATION EFFECTS ON MIDGUTS AND TESTES OF THE ADULT BOLL WEEVIL, ANTHONOMUS GRADIS, DETERMINED BY HISTOLOGICAL AND SHIELDING STUDIES. Riemann, John G.; Flint, Hollis M. (Dept. of Agriculture, Fargo, N. D.). Ann. Entomol. Soc. Amer., 60: 298-308(Mar. 1967).

Histological studies demonstrated that γ radiation doses considerably below those required for sterilization killed most regenerative cells of the midgut epithelium of boll weevils, and resulted in the loss of most or all of the secretory epithelium. Extensive damage to the midgut was noted in one specimen that received 2000 R and in all those given 4000 R. Shielding experiments showed that when only the head and that part of the thorax anterior to the midgut were irradiated, mortality did not exceed that of the control. Irradiation of the abdomen and the posterior part of the thorax produced the same level of mortality as did whole-body irradiation. The findings indicated that damage to the midgut was the basic cause of the high mortality among weevils exposed to sterilizing doses of radiation. At 10 days after irradiation, no spermatogonia were found in any testes irradiated with 6000 R or more, and none were found in some testes that received only 2000 R. (BBB)

34767 GAMMA RADIATION EFFECTS ON NYMPHS OF THE DAMSELFLY ARGIA TRANSLATA. Wixson, Bobby G. (Univ. of Missouri, Rolla); Clark, William J. Ann. Entomol. Soc. Amer., 60: 485-6(Mar. 1967).

Nymphs of Argia translata in the final instar stage were exposed to γ radiation doses of 750, 7150, and 71,000 rad at a dose rate of 710 rad/min. The median tolerance limit (TL_m) values calculated from observed data were: 24 hr, 15×10^4 rad; 48 hr, 92×10^3 rad; and 72 hr, 52×10^3 rad. An unusual phenomenon of accelerated emergence was noted in the groups that received 750 and 7150 rad. Adult emergence was 1% in the control groups during the 72 hr of the experiment, yet 9% of the 750-rad group completed normal emergence during this period. In the 7150-rad group, 12% attempted emergence but only 50% completed it successfully; the others were unable to straighten the wings or the abdomen into the normal adult position. There was no emergence in groups given 71,000 rad or more. (BBB)

34768 CHANGES IN CONDITIONED REFLEX ACTIVITY AND GASTRIC SECRETION DURING RADIATION SICKNESS. Perepelkin, S. R. (Medical Inst., Moscow). Radiobiologiya, 6: 851-9 (1966). (In Russian).

The changes in conditioned reflex activity and gastric secretion during radiation sickness were studied in three male dogs kept on a meat diet and subjected to whole-body x irradiation at a dose of 400 R. The dynamics of gastric secretion in the acute and subacute forms of development of radiation sickness in the dogs were sharply wave-like or periodic in character, with a considerable intensification of the process studied. The increase in the enzymatic activity of the gastric juice was more substantial than the secretion of gastric juice. The disturbances of gastric secretion were more pronounced against a background of a meat diet than in the case of the physiological diet observed in previous experiments. During the development of radiation sickness, a disturbance of the cerebral cortex activity was noted, expressed as a change in the strength ratios, a weakening of the internal inhibition, manifested as disinhibition, or the appearance of incomplete differentiation, intensification of the process of inhibition with occasional extinction of the conditioned reflex. The response of the glandular apparatus of the stomach to the influence of ionizing radiation is more pronounced than that of the cerebral cortex. (JPRS)

34769 ON THE PROBLEM OF INTENSIFYING RADIORESISTANCE OF RABBITS BY IMMUNIZATION WITH SMALLPOX VIRUS VACCINE. Kamalyan, L. A. (Sector of Radiobiology, Erevan). Radiobiologiya, 6: 860-2(1966). (In Russian).

The survival rate and course of radiation sickness in rabbits irradiated at various times following immunization with smallpox vaccine were studied. The rabbits were subjected to whole-body x irradiation at a dose of 700 or 1000 R. Preliminary smallpox vaccination was found to increase the resistance of the animals to irradiation, shown by a higher survival rate and a lighter course of radiation sickness. The greatest radioresistance was noted during the period of maximum intensity of the smallpox immunity. (JPRS)

34770 SOME GROWTH PECULIARITIES OF X-IRRADIATED HeLa CELLS AND THEIR CHEMICAL PROTECTION FROM RADIATION BY MEANS OF CYSTEAMINE. Todorov, Sv.; Ivanov, B. Rentgenol. Radiol., 5: 93-8(1966). (In Bulgarian).

Data are presented on the effects of different doses of x rays upon the regeneration time of HeLa cells. The normal regeneration time of the cell line was 26.5 hrs. Irradiation with 100 R lengthens the regeneration time by 10.5 hr; with 200 R, by 23.5 hr. A dose of 500 R completely suppresses the reproductive ability of the cells. On the basis of the obtained data, the cell line is considered radiosensitive, because its regeneration time increases by 6 to 7 min/R in comparison with 1 min/R obtained normally in tissue cultures. Cysteamine had a pronounced protective action on the reproductive ability of the HeLa cells, even in case of full suppression of regeneration with 500 R. (JPRS)

34771 STUDIES OF SPERMOGRAMS OF PERSONS PROFESSIONALLY EXPOSED TO IONIZING HAZARDS. Vaskov, L.; Gospodinova, D. (Research Inst. of Radiology and Radiation Hygiene, Sofia). Compt. Rend. Acad. Bulg. Sci., 19: 325-8 (1966).

Studies were conducted to establish whether there appear any changes in the spermogram of persons with long-term occupational exposure to ionizing radiations and, if so, to study their character and extent. A total of 104 men ranging in age from 20 to 43 years were divided into two groups, an experimental group of 53 men, who had worked with ionizing radiation for 8.93 years on the average and were subjected primarily to gamma and x irradiation in doses that did not exceed the maximum permissible ones; and a control group consisted of 51 clinically healthy men not exposed to ionizing radiation. Results show a statistically significant reduction in the percentage of mobile spermatozoa in persons with long-term exposure to ionizing radiation hazards by 50%. (TSS)

34772 ELECTRON-MICROSCOPE PICTURE OF MITOCHONDRIA OF RAT LIVER AFTER WHOLE BODY IRRADIATION BY 1400 R. Tichy, J.; Hradil, I.; Lejsek, K. (Charles Univ., Hradec Kralove, Czechoslovakia). Cesk. Fysiol., 15: 133(Feb. 1966). (In Czech).

Experiments were conducted on 18 white rats. Microscopic examination took place 15 and 60 minutes after the irradiation. No differences between the liver of irradiated rats and controls were found; only the number of vacuoles increased. (HPRS)

34773 NORMAL DEVELOPMENT OF THE EMBRYO OF THE ARACHNID CUPIENNIUS SALEI KEYSERLING AND ITS REGULATORY CAPACITY AFTER X IRRADIATION. Seitz, Karl-August (Philipps-Univ., Marburg/Lahn, Ger.). Zool. Jahrb., Abt. Anat. Ontog. Tiere, 83: 327-447(1966). (In German).

Studies made on ova of Cupiennius salei (Ctenidae) are reported. Methods and materials used in collection of the organisms and their cocoons, observations of life habits, and sample preparation and sectioning are outlined. Methods of x irradiation included irradiation of entire ova with 55 kV x ray with doses of 15 to 2000 R in dose steps of 15, 50, and 100 R. Irradiations of specified portions of the ova, in order to produce specific developmental defects, were made with doses of 3720, 4650, 8370, 13,020, 17,670, and 22,300 R. The characteristics of the normal, fresh ovum and its development, including formation of the blastoderm, formation of the perivitelline space, differentiation of the germinal axis and induction of the unsegmented germinal band, segmentation of the germinal band, development of the extremities, dorsal groove, and the involution and formation of the first postembryonal stage are compared and described. The radiosensitivity and recovery processes after total irradiation are described in terms of the evaluation of the radiosensitivity at various stages of embryonic development, fractional distribution of normal, complete embryos and embryos without a germinal band (100% lethal) after total irradiation of the blastoderm, and the sequence of injuries following total irradiation of a 22 to 35 hr blastoderm. (BBB)

34774 BIOLOGICAL EFFECTS OF IRRADIATED FOOD. I. EFFECT ON LYMPHOCYTE NUMBERS IN THE PERIPHERAL BLOOD OF THE RAT. Ehrenberg, L.; Loefroth, G.; Ehrenberg, A. Arkiv Zool., 18: 195-216(1967).

Sprague–Dawley rats fed γ-irradiated standard animal food exhibited a 15 to 20% decrease in the absolute lymphocyte count in peripheral blood. Other cell types were not affected. The effect was observed within a few days to a few weeks after the start of feeding. Within the dose range tested, 3 to 9 MRAD, the effect was independent of dose. It was also independent of whether ½ or the whole diet was irradiated. Therefore, the effect could be ascribed to loss of necessary nutritional components. The postulated biologically active compound(s) was not destroyed by storage of the irradiated food for 1 yr at −20 or + 25°C. If feeding of irradiated food was continued for 1 to 2 yr, no further general decrease in lymphocyte count was observed below the level reached within a few weeks. In contrast to the total level of leukocytes, the lymphocyte count of the controls decreased slowly with increasing age. The magnitude of the observed effect of irradiated food was comparable to the action of acute whole-body γ irradiation of the animals within about 20 RAD, or chronic irradiation at about 1 RAD/day. (BBB)

34775 RADIATION SYNDROME IN POULTRY. Gligorijevic, J.; Rusov, C. (Inst. for the Application of Nuclear Energy in

Agriculture Veterinary Medicine and Forestry, Belgrade). Vet. Glas., 20: 743-7(1966). (In Slovak).

One-year-old White Rock roosters (74) were x-irradiated at 20 R/min with total whole-body doses of 400, 600, and 1200 R. Hemotologic data between 30 min to 63 days postirradiation revealed that changes were essentially the same as in other domestic animals except that roosters seemed slightly more radioresistant. (JPRS)

34776 EFFECTS OF PHOTOPERIOD AND OF ULTRAVIOLET RADIATION ON THE INCIDENCE OF DIAPAUSE IN THE HORN FLY, HAEMATOBIA IRRITANS (L.) (DIPTERA: MUSIDAE). Depner, K. R. (Canada Agriculture Research Station, Lethbridge, Alta.). Int. J. Biometeorol., 5: 68-71(1962).

Two generations of flies were subjected to a 12-hr photoperiod vs a 16-hr one, while in three generations the comparison was between a 16- and a 20-hr photoperiod. In another check 2 yr later five generations of horn flies were subjected to 14- vs 18-hr photoperiods. The effect of wavelength 7800 to 2800 Å was also investigated. More pupae entered diapause following a 12-hr photoperiod than one of 16-hr and more after 16 hr than 20 hr. Up to 14 times as many pupae entered diapause after the 12-hr photoperiod than after the 20-hr photoperiod. The results were confirmed in pupae from adults exposed to 14- and 18-hr photoperiods. The average diapause was 14.4% after 14 hr and 7.26% after 18 hr. The effect of uv radiation on the inception of diapause in 6 generations of horn flies was tested. Adults of 5 generations were exposed to 20-hr photoperiods and adults of one generation to 16 hr. At the photoperiods used, the addition of uv radiation to fluorescent light resulted in a reduction in the percentage diapause of the pupae. In one generation, the effect was reversed; a possible explanation is given. (BBB)

34777 STUDIES ON THE ERADICATION OF ANOPHELES PHAROENSIS BY THE STERILE-MALE TECHNIQUE USING ^{60}Co. IV. MATING BEHAVIOR AND ITS FREQUENCY IN THE STERILIZED MOSQUITOES. Tantawy, A. O.; Abdel-Malek, A. A.; Wakid, A. M. (Middle Eastern Regional Radioisotope Center for the Arab Countries, Cairo). J. Econ. Entomol., 60: 23-6(Feb. 1967).

When ^{32}P was put in the rearing medium of Anopheles pharoensis larvae to give radioactive males, their sperm could be detected after copulation with normal females. Normal females mated with radioactive males that were exposed to levels of 0.1 and 0.2 μCi/ml, showed low but detectable radioactivity that reached double the background in the former dilution and much more in the latter. The ability of the male to mate with more than one female was investigated using ^{32}P-labeled individuals. One tagged male was introduced into a cage containing 15 virgin females. Each male mated with 4 to 6 females. Another experiment was conducted to compare the ability of irradiated and nonirradiated males (normal) to mate with virgin females. Males irradiated with ^{60}Co doses as high as 12,000 R were found to be as effective as normal males in inseminating normal virgin females. Males obtained from the field as pupae and bred in the lab showed the same ability as the lab-reared males in inseminating females when both kinds of males were isolated with the same number of females. (BBB)

34778 KINETIC STUDY OF RADIOLESIONS OF THE TESTICLE IN THE RAT. ABSENCE OF PROTECTIVE EFFECT OF CYSTEAMINE. Maldague, P.; Maisin, H. (Institut du Cancer, Louvain). Pathol. Eur., 1: 67-84(1966). (In French).

Development of x-ray-induced testicular lesions in 4-month-old rats was studied by a quantitative histologic method. Total-body irradiation with a dose of 300 R produced successive and temporary disappearance of spermatogonia on the 7th day, spermatocytes on the 21st day, spermatids on the 35th day, and spermatozoids on the 49th day after irradiation. Regeneration of spermatogonia was already perceptible on the 28th day; spermatozoids reappeared only by the 80th day after irradiation. Cysteamine injection at a dose of 75 mg/Kg had no protective effect on the lesions induced by x rays in the testis, and regeneration of the germinal epithelium. (BBB)

34779 LASER EFFECTS ON TWO INSECTS. Wilde, W. H. A. (Ontario Agricultural Coll., Guelph). Can. Entomol., 97: 88-92(Jan. 1965).

Dermestid larvae, Trogoderma versicolor, and adult American cockroaches, Periplaneta americana, were exposed to ruby laser pulses of 2 intensities, 0.06 per 10^{-7} sec duration and 0.57 J per 0.2 msec. Laser impact areas were 1.5 mm in dia. The first intensity, directed at cephalic regions of dermestid larvae, caused mortality in 3 to 48 hr. The same intensity directed at larval midabdominal areas caused visible outer integument and body-hair scorching; cessation of feeding, growth rate, and movement; and loss of negative phototactic responses. Directed at posterior abdominal regions of larvae, it caused damage to the epidermal layer noticeable in 4 succeeding molts. It caused temporary (10 to 15 min) immobility and loss of negative phototaxis when directed at prothoracic regions of cockroach adults. P. americana adults were more severely affected by the second laser treatment, exhibiting immobility, loss of negative phototaxis, and cessation of eating. Total mortality in the 5 treated specimens occurred in 8 to 14 days as compared with 45 to 68 days in controls. (BBB)

34780 EFFECT OF THE EXTIRPATION OF THE SUPRARENAL GLAND ON THE SALT AND WATER METABOLISM OF THE RATS IRRADIATED WITH LETHAL DOSE. Laszlo, Gyozo; Sigmond, Aniko. Magy. Radiol., 19: 154-8(June 1967). (In Hungarian).

The effect of the extirpation of the suprarenal gland on the salt and water metabolism of the rats irradiated with lethal dose. On the basis of animal experiments, it was stated that the x irradiation injury and the extirpation of the suprarenal gland exerted synergic influence in decreasing the survival time. The disturbance of the sodium and water metabolism did not explain the animals' death. (auth)

34781 ROLE OF THE MOUSE LYMPHOMA VIRUS OF MOLONEY IN INDUCTION OF MYELOID LEUKEMIA BY X-IRRADIATION. Takizawa, Schoichi; Ito, Akihiro (Hiroshima Univ.). Nippon Ketsueki Gakkai Zasshi, 29: 42-8(Feb. 1966). (In Japanese).

In an attempt to elucidate the relation of the type of leukemia induced by the leukemogenic agent and the host factor, the role of the mouse lymphoma virus (Moloney virus) and effect of thymectomy in induction of myeloid leukemia by x radiation were studied in mice. The incidence of myeloid leukemia in unoperated irradiated mice was trebled (from 9.7% to 29.4%) and the development of thymic lymphoma was prevented by thymectomy prior to irradiation. This could be attributed to the fact that thymectomy gave more chance for development of myeloid leukemia through preventing death from thymic lymphoma. The incidence of myeloid leukemia in these mice was further increased by the Moloney virus infection (from 29.4% to 66.6%) without affecting the incidence of lymphomas, suggesting the acceptance of the virus by the myelogenic cells during heightened proliferating activity after irradiation. Myeloid leukemias induced by x radiation plus Moloney virus were indistinguishable from those induced by x radiation alone as far as their morphology is concerned, and were transplantable in syngeneic adult mice. (NSA of Japan)

34782 TIME-LAPSE MICROPHOTOGRAPHY OF DELAY IN DIVISION OF THE RHABDITIS OVUM INDUCED BY UV. Richter, I.-E. (Johann-Wolfgang-Goethe Univ., Frankfurt am Main). Protoplasma, 62: 237-45(Aug. 5, 1966). (In German).

Ova of two types of the nematode, Rhabditis, were irradiated with uv microlamps with relative peak intensities of 300 and 400 nm. Time lapse photographs of the irradiated ova were taken at 30 frames/min. When the cytoplasm of the ova was irradiated after insemination the coalescence of the prenucleus which occurs during fertilization was prevented. It was assumed that the cause of this was the absence of the contract waves which were normally required, because of a depression of viscosity in the cells. If the contraction waves that appear in the course of coalescence of the prenucleus are already established or are partially or already completed, then the uv sensitivity of the ova is markedly reduced. In this case, whatever delay there may be in partition of the cell is not measurable. The delay in mitosis is used for reversal of the partition events in the 2-cell stage. If the blastomer II partitions first, then the spindle movements in blastomer I do not produce a definite position of the plane of partition, as is usually the case in untreated ova. (BBB)

34783 VASCULAR ALTERATIONS OF LARGE ABDOMINAL MUSCLES IN GUINEA PIGS AFTER X IRRADIATION. MICROANGIOGRAPHIC STUDY. Nicolato, A.; Rodolico, R. (Univ., Padua). Radiobiol. Radioter. Fis. Med., 21: 381-9(Nov.-Dec. 1966). (In Italian).

Studies by means of microangiography were made on the alterations caused by x rays in the small vessels of the large abdominal muscles in guinea pigs. Observations were made at one hour, seven and fifteen days after treatment with x rays. The appearance of vascular alterations were attributed to physiological changes. (auth)

34784 THE MECHANISM OF RADIATION-INDUCED CONTRACTURE OF STRIATED MUSCLES. Nadareishvili, K. Sh.; Sanebilidze, O. I. (Inst. of Physiology, Tbilisi, USSR). Radiobiologiya, 7: 214-20(1967). (In Russian).

Irradiation (40 to 60 kR/min, total 75 to 120 kR) of isolated frog skeletal muscles causes spontaneous, long-lasting contraction of both tonic and tetanic curarized muscles and also of preparations after preliminary destruction of the membrane and myofibrillar

transmission of excitation. Conformational changes, intra- and intermolecular, reversible and irreversible, can be the cause of the radiation contracture. In experiments with irradiation of myosin and actomyosin solutions, gel formation and syneresis of the actomyosin gel were detected, and also change of the viscoelastic properties of monomolecular layers of contractile proteins. (tr-auth)

34785 SENSITIZATION OF THE ANIMAL ORGANISM TO THE ACTION OF FAST NEUTRONS AND γ-RAYS BY BORANE DERIVATIVES. Romantsev, E. F.; Stanko, V. I.; Kozyreva, E. V. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 147-8(1967). (In Russian).

The effects of boranylacetic acid, methylboranecarboxylic acid, and borane in sensitizing animals to radiation were studied in experiments in which mice were irradiated with fast neutrons in sublethal doses and rats with 750 R of γ-rays. As indicated by the rate of survival and the length of the time of survival of the animals, boranylacetic acid and methylboranecarboxylic acid sensitized the animals to the action of radiation. The experiments with rats showed that borane also had a sensitizing effect; however, this effect was less pronounced than that exerted by its two derivatives. The sensitizing action of borane in neutron irradiation was presumably due to the reaction $^{10}B + n \rightarrow {}^{7}Li + 2\alpha$. (JPRS)

34786 EFFECT OF γ-IRRADIATION ON THE ADAPTIVE SYNTHESIS OF TRYPTOPHANPYRROLASE IN THE RAT LIVER. Auzin, A. M.; Mel'nikova, S. K. (Inst. of Biological Physics, Moscow). Radiobiologiya, 7: 37-41(1967). (In Russian).

The effect of γ-irradiation of rats at a dose of 1000 R on the adaptive synthesis of tryptophanpyrrolase in the liver was studied. Within 4 hrs after irradiation, inhibition of the adaptive synthesis began. The synthesis was inhibited to the extent of 50% and 90 to 100% 24 hrs and 3 days after irradiation, respectively. The activation of the enzyme produced by cortisol was not inhibited by irradiation. Irradiation did not inhibit activation of the enzyme produced 2 hrs after introduction of l-tryptophan acting as an inductor and due to increased saturation of the enzyme with a cofactor of hemin origin, but suppressed to a pronounced extent the subsequent induction (5 hrs after the introduction of tryptophan) associated with the synthesis of the enzyme protein. Suppression of the latter effect amounted to ~70% 24 hrs after irradiation. Irradiation eliminated the capacity of microsomes to activate tryptophanpyrrolase in cell juice. In the terminal stage (2 to 3 days after irradiation of the animals) the activity of tryptophanpyrrolase in the liver increased parallel to an increase of the level of corticosteroids in the body of the animals. This increase in the activity of the enzyme did not take place after irradiation of adrenalectomized animals. (JPRS)

34787 RELATIVE BIOLOGICAL EFFECTIVENESS OF 15 MeV X-RAYS AND ELECTRONS, AND 200 KV X-RAYS ON EHRLICH ASCITES TUMOR OF MICE. Nakatsuka, Haruo; Takeuchi, Tetsuichi; Ochi, Nobuhiro; Fujino, Moriji (Osaka City Univ.). Osaka Shiritsu Daigaku Igaku Zasshi (Japan), 15: 641-6(Dec. 1966). (In Japanese).

A comparative study was made of the biological effect of 15 MeV betatron x rays and electrons on Ehrlich ascites tumor. The biological effectiveness of MeV radiation and 200 kV x rays on the regression of mouse subcutaneous tumor was studied. Reduction in growth rate was less following betatron irradiation than following 200 kV x irradiation. The duration of depression of mitotic activity of Ehrlich ascites tumor cells was studied following betatron irradiation and 200 kV x irradiation. A 15 MeV betatron radiation was less effective on the mitotic activity than with 200 kV x rays. The reproductive capacity of Ehrlich ascites tumor cells in vivo following irradiation has been determined following Hewitt and Wilson's method. The extrapolation numbers and Do of survival curves were: n = 2.1, Do = 243 R, for 15 MeV x rays; n = 2.9, Do = 239 R for 15 MeV electrons; n = 1.6, Do = 117 R for 200 kV x rays. (auth)

34788 RELATIVE BIOLOGICAL EFFECTIVENESS OF 15 MeV ELECTRON BEAMS AND 200 KV X RAYS ON THE LETHALITY AND BONE MARROW DAMAGE OF MICE FOLLOWING WHOLE BODY IRRADIATION. Nakatsuka, Haruo; Fukui, Yoshinori; Fujino, Moriji (Osaka City Univ.). Osaka Shiritsu Daigaku Igaku Zasshi (Japan), 15: 523-9(Dec. 1966). (In Japanese).

The relative biological effectiveness of 15 MeV electron beams and 200 kV x rays was determined on the basis of lethal effect and bone marrow damage in mice. Nucleated bone marrow cell counts were used as a criterion of radiation effect on the bone marrow tissue. The RBE for 15 MeV electron beams versus 200 kV x rays as determined by lethality of mice was 0.66, and RBE value as determined by bone marrow damage was 0.70. When a definite method of dosimetry for such high energy electron beams is established, the RBE value tentatively derived in the present study may be subjected to some change. (auth)

34789 EFFECTS OF IONIZING RADIATION ON THE EMBRYOHISTOGENESIS OF THE SOMATIC MUSCULATURE OF THE MOUSE. Klishov, A. A. (Academy of Military Medicine, Leningrad). Radiobiologiya, 7: 235-9(1967). (In Russian).

Fifty pregnant mice were irradiated once with 150 or 200 R on the 12th, 15th, 18th, or 20th days of pregnancy and killed in 6 hours, 1, 2, 3 and in some cases 5 and 7 days after irradiation. Sixty irradiated and unirradiated embryos were examined histologically. The data obtained indicate high radioresistance of cell elements in the myoblast and myosymplast stages; in the next stage, the muscle tubes undergo massive decomposition if irradiated. Irradiated muscle fibers reveal no structural differences from unirradiated. (JPRS)

34790 INFLUENCE OF γ-RADIATION ON ANTIBODY PRODUCTION BY SPLEEN CELLS IN VIVO. Man'ko, V. M.; Petrov, R. V. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 229-34 (1967). (In Russian)

The effects of doses of 100 to 20,000 R on antibody production by spleen cells in lethally irradiated recipient mice were investigated, using L. canicola as the antigen. The results showed that the antigenic stimulation of spleen cells is possible in vivo or in vitro, directly before transfer of cells to lethally irradiated recipients. In the range of doses of 100 to 800 R in vitro, the phase of reception of the antigen is far more radiosensitive than the productive phase. Inactivation of the cell function is intense up to 800 R and less intense in the range of 800 to 20,000 R. (JPRS)

34791 KINETICS OF LYMPHOCYTE SATURATION OF MOUSE AND RAT MARROW BY LOCAL IRRADIATION. Kabakov, E. N.; Fofanova, K. A.; Perestoronina, N. N. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 7: 199-203(1967). (In Russian).

Mice and rats were irradiated with whole-body doses of 1070 R and local doses of 2140 R and changes in the number of cells and lymphocytes and of the erythmyeloid part were determined at intervals. The results are presented graphically and show that the difference in marrow destruction in whole-body and local irradiation is greater saturation with lymphocytes in the latter case; the degree of destruction of the erythmyeloid part is identical in both cases. The difference evidently can only be a result of migration of lymphocytes into the marrow from the peripheral blood, but the participation of those cells in the regenerative process is not yet clear. (JPRS)

34792 DATA ON THE MECHANISM OF THE RADIOBIOLOGICAL EFFECT OF THE RADIATION DOSE RATE. Smirnov, O. P. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 289-93(1967). (In Russian).

The dependence of $LD_{50/30}$ on the dosage rate obtained in experiments on mice permitted distinguishing that the oxygen effect is not manifested in the 3 to 6 R/min dose range, but is manifested in the 280 to 3060 R/min range. It is assumed that the difference is connected with distinctive features of oxygen utilization in the irradiated biological substrata. (JPRS)

34793 INFLUENCE OF IONIZING RADIATION ON THE DNA OF WHITE RAT LIVER TISSUE IN ONTOGENESIS. Ivanov, I. I.; Borovikova, O. N.; Dolgo-Saburov, V. B.; Sharobaiko, V. I. (Academy of Military Medicine, Leningrad). Radiobiologiya, 7: 171-4(1967). (In Russian).

In the livers of embryos and new-born white rats the blood cell count decreased greatly but the parenchyma cell count was practically unchanged after irradiation with 1000 R. In the parenchyma cells the DNA content was not greatly reduced and the DNA polymerism was unchanged. The findings point out the known arbitrariness of classifying entire organs on the basis of radiosensitivity, since they include cellular elements with different behavior. (JPRS)

34794 THE INFLUENCE OF ^{90}Sr ON RAT HEMOPOIESIS UNDER CONDITIONS OF INCREASED FLUORINE AND CALCIUM INTAKE WITH THE DIET. Belousova, O. I.; Grozovskaya, V. A.; Knizhnikov, V. A. (Inst. of Biophysics, Moscow). Radiobiologiya, 7: 297-300(1967). (In Russian).

Myeloid hemopoiesis was affected in rats receiving ^{90}Sr per os in divided doses totalling two μCi/g and was restored in one month. Analyses were made of indicators in the peripheral blood and the tabulated results show that rats receiving supplementary fluorine and calcium in their food and water recovered more rapidly than rats not receiving those supplements. (JPRS)

34795 INFLUENCE OF INCORPORATED RADIOACTIVE ISOTOPES OF STRONTIUM, CESIUM, AND CERIUM ON THE CARDIAC ACTIVITY OF RATS. Sel'tser, V. K. (Scientific Research Inst. of Radiation Hygiene, Leningrad). Radiobiologiya, 7: 302-6(1967). (In Russian).

Cardiopolygraphic investigations of rats at 30-day intervals revealed no changes in cardiac activity after daily administration of radioactive isotopes of strontium (0.08 mCi per rat) for 60 days and of Cs (0.01) and Ce (1.6) for 180 days. On the 300th day of Ce treatment, slight changes appeared in the systolic structure, along with increase of the inhibiting influence of ether narcosis on the cardiac rhythm. After 150 days of Ce treatment and 180 days of Cs treatment sensitivity to intravenously administered adrenalin was greatly reduced. (tr-auth)

34796 THE PRESENT STATUS OF THE PROBLEM OF RADIOSENSITIVITY AND SOME DIRECTIONS FOR ITS INVESTIGATION. Kerkis, Yu. A. (Inst. of Cytology and Genetics, Novosibirsk, USSR). Radiobiologiya, 7: 251-7(1967). (In Russian).

Many unsolved problems of radiosensitivity are discussed including: the different sensitivities of organisms and cells; the absence of a criterion that helps to understand the phenomenon; the mechanisms and level of activity of restorative systems; correlation of the radiosensitivity of the organism, measured viability and the sensitivity of nuclear structures; intracellular mechanisms controlling radiosensitivity; the genetic conditioning, the specificity and non-specificity of radiosensitivity; its connection with the immunological state of the organism, with metabolic processes; the development of mutations, etc. (JPRS)

34797 CO_2 LASER IRRADIATION OF THE RABBIT EYE, CLINICAL AND HISTOPATHOLOGIC OBSERVATIONS. Fine, B. S. (AFIPS and George Washington Univ., Washington, D. C.); Zimmerman, L. E.; Fine, S. pp 160-1 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

Studies were carried out on rabbit eyes to evaluate the short- and long-term effects of CO_2 laser radiation (10.6μ) on the ocular media. Descriptions of the radioinduced injuries that were determined by clinical and histopathological examination are given. It was concluded that protective measures should be taken when high-power CO_2 lasers are used. (B.H.S.)

34798 EFFECT OF PULSED LASER RADIATION ON DISCRIMINATIVE AVOIDANCE BEHAVIOR. Taylor, H. L.; Ebbers, R. W. (Air Force Systems Command, Holloman Air Force Base, N. Mex.). pp 162-3 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

The effects of pulsed laser radiation on lever pressing behavior maintained by a discriminative shock avoidance was investigated. Two female rhesus monkeys (Macaca mulatta) were the experimental animals. The subjects were trained until response rate was stable, and then the following schedule was accomplished: three days of baseline; one day of preirradiation sham; one day of laser irradiation; and one day of postirradiation sham. Rate of response was measured during the baseline sessions and compared to the response rates obtained during the sham and laser sessions. Data clearly indicated that the average rate of response was not affected by a single pulse of laser radiation. (B.H.S.)

34799 BIOPHYSICAL STUDIES WITH THE CO_2 LASER. Fine, S. (Northeastern Univ., Boston); Hansen, W. P.; Peacock, G. R.; Klein, E.; Hust, F.; Laor, Y. pp 166-7 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

A heat flow analysis of threshold dose for lesions in rodent skin and tissue ablation in rabbits produced by CO_2 laser radiation is summarized. Equations for determining one-dimensional heat flow in a uniform, semi-infinite medium and equations for determining absorption coefficients in a completely opaque medium are given. Based on experimental data, it was concluded that the values of CO_2 laser power density and exposure time that will result in ~100% probability of producing a mild, immediate skin lesion in mice could be calculated. (B.H.S.)

34800 EFFECTS OF SUPRARENAL STIMULATION WITH CORTICOTROPIC HORMONES ON WHOLE-BODY ^{60}Co γ-IRRADIATED RATS. Trinci, M. (Univ., Rome). Nunt. Radiol., 32: 437-53(May 1966). (In Italian).

Consideration was given to the possibility that the absence of any correspondence between adrenal response and administered doses of γ radiation depended upon an exhaustion of the corticotropic stimulus. Experiments were carried out of γ-irradiated rats injected with ACTH and on irradiated controls. Changes in body weight and weight of various organs, histology of adrenal glands, kidneys, liver, spleen, and testes, and the lethality index were analyzed. It was concluded that the corticoadrenal response of the irradiated rats did not seem to be enhanced by a further stimulation by ACTH and that it should be considered as the maximal possible reaction for the subject under examination. (B.H.S.)

34801 COMPARISON OF THE RATES AT WHICH COLONY FORMING UNITS AND ERYTHROPOIETIN RESPONSIVE CELLS RECOVER AFTER 200 r TOTAL BODY X-IRRADIATION. Weisman, M.; Martinson, D.; Fried, W.; Gurney, C. W. (Univ. of Chicago). Contract AT(11-1)-69. J. Lab. Clin. Med., 69: 438-46(Mar. 1967). (ACRH-1000-2).

The rate of recovery of colony-forming units in the leg, as measured by an endogenous spleen colony technique, is similar to the recovery ability of polycythemic mice in response to a standard erythropoietin injection after receiving the same dose of x radiation. Although this similarity may be coincidental, it suggests that colony-forming units and erythropoietin-responsive cells are closely related, if not identical lines of cells. (auth)

34802 TESTICULAR TUMORS: ANALYSIS OF 196 CASES TREATED AT THE U.S. NAVAL HOSPITAL IN SAN DIEGO. Kurohara, S. S.; George F. W.; Dykhuisen, R. F.; Leary, K. L. (Naval Hospital, San Diego, Calif.). Cancer, 20: 1089-98(July 1967).

An analysis of 196 cases of testicular tumors treated at the U.S. Naval Hospital, San Diego, between 1945 and 1965, are presented and compared with those of other recent series. Results are similar to those of other recent series. Results are similar to those of other recent series, especially to U.S. Army series. Prognosis, influenced by the histology of the tumor, was poorer in patients with groups II, IV and V lesions than in those with groups I and III lesions. There was a parallel relationship of the effects of clinical stage, symptom duration and testicular size on the survival of patients with carcinoma (group II + IV) but not, within certain limits, with that of patients with seminoma (group I). This indicates that, for patients with carcinoma, the longer the delay in treatment, the larger will be the tumor and the greater will be the risks of metastasis and early death. Gynecomastia or testicular pain or the discovery of testicular tumor due to early metastasis also affected survival. Radical treatment of the potential sites of metastasis, whether by high volume-dose ^{60}Co irradiation alone or in combination with lymphadenectomy, greatly improved the survival of patients with carcinoma over that obtained by low-dose x-irradiation alone from 40 to 75% whereas moderate volume-dose ^{60}Co irradiation improved slightly the previously high results obtained in seminoma by x irradiation alone from 85 to 98%. (auth)

34803 EFFECT OF THE EMISSION OF A PULSED RUBY LASER ON THE CORNEA OF THE EYE. Sevast'yanova, L. A. Biophysics, 11: 336-40(1966).

Translated from Biofizika, 11: 295-8(1966).

Scattered pulsed irradiation of the ruby laser caused changes in the cornea of white mice. The degree of these changes was determined by the size of the radiation dose. If, however, the integral doses did not exceed approximately 0.05 to 0.01 J/cm^2 then no deviations from normal were seen. Apparently there was a certain threshold energy of emitting radiation (E_{thres}) below which disturbances in the cornea were virtually absent. This qualitatively concurred with the results of investigations on the effect of pulsed white light on the cornea of white mice and also on the rabbit retina. However, it should be noted that in the case of a ruby laser the value of the threshold energy was lower than on irradiation with pulsed white light (1.5 to 3 J/cm^2). Another interesting point was that the values of E_{thres} for white light in order of magnitude did not greatly differ from the threshold energy obtained in work for the rabbit eye (0.45 J/cm^2). The results obtained on repeat irradiation of animals indicated that with increase in the number of light pulses following after an interval of even one day, their effect was cumulative. In fact, on repeat irradiation of animals with sets of two pulses each, i.e., doses known to be less than E_{thres}, both the changes in the cornea and times of the restorative processes were approximately the same as after irradiation with one series of 5 to 7 pulses. Comparison of the results with the findings on the action on the cornea of high frequency electromagnetic, ultraviolet or γ-radiation showed that the disturbance in the cornea in all these cases were essentially similar and were characteristic of an inflammatory process. (auth)

34804 SOME PECULIARITIES OF THE HIGHER NERVOUS ACTIVITY IN ADULT ANIMALS SUBJECTED ANENATALLY TO THE ACTION OF IONIZING RADIATION. III. THE STATE OF THE HIGHER NERVOUS ACTIVITY IN ADULT WHITE RATS EXPOSED TO X RAYS AT THE PREIMPLANTATION STAGE OF EMBRYONAL DEVELOPMENT. Piontkovskii, I. A.; Gol'dberg, M. B.; Miklashevskii, V. E. (Inst. of Higher Nervous Activity, Moscow). Bull. Exp. Biol. Med. (USSR) (Engl. Transl.), 51: 24-8(Jan. 1961).

Female albino rats were subjected to a single whole-body x-ray dose of 200 R on the 5th day of pregnancy. Central nervous system activity of the progeny of these rats was studied in the 45- to 50-day-old animals. A conditioned reflex program based on sound and light signals with food reward was used to test development and maturation of the central nervous system. The results obtained demonstrated that the excitation and inhibitory processes in the animals, irradiated at the early stage of embryonic development, were retarded (according to some parameters) in comparison with those in control nonirradiated rats; however, this retardation was insignificant, especially as compared to that found earlier occurring in animals irradiated on the 12th to 18th day of antenatal development. The insignificant functional deviations noted in the higher centers of the nervous system probably depended upon the humoral factors, resulting from the changes in the mother because of radiation sickness. (BBB)

34805 TRAUMATIC SHOCK, X IRRADIATION, AND AVOIDANCE BEHAVIOR. Whaley, Donald L.; Scarborough, Barron B.; Reichard, Sherwood M. (Florida State Univ., Tallahassee). Physiol. Behav., 1: 93-5(Jan. 1966).

The prospect was investigated that animals made resistant to drum-trauma in an apparatus similar to that used by Noble and Collip might also exhibit attenuated reactions to low-dose ionizing irradiation. The saccharin avoidance phenomenon provided the dependent measures. While saccharin solutions are usually preferred to the exclusion of tap water, if the presentation of saccharin is contiguous with the administration of relatively low doses of ionizing irradiation, the previously preferred solution is subsequently avoided. Irradiation procedures began 24 hr after termination of drum-trauma manipulations. The animals were irradiated with a dose rate of 6 R/min and total dose of 60 R. Sham-irradiation groups received the same procedure as the radiation groups with the exception that the x-ray machine was not activated. Directly after irradiation, the animals were presented with a choice of tap water and saccharin solutions. Saccharin consumption was significantly depressed in both trauma-resistant irradiated and normal irradiated groups from unirradiated groups. However, while trauma-resistant irradiated rats exhibited an avoidance behavior, the degree of avoidance was significantly less than in the irradiated-only group. The results indicated that prior experience in the tumbling apparatus lessened the saccharin avoidance response relative to other groups. If the degree of saccharin avoidance exhibited is a reliable and valid index of tissue damage resulting from irradiation, it appears that tumbling experience may mitigate these tissue reactions. The reason for this mitigation of the radiation response in animals made resistant to drum-trauma remains speculative. The existence of a basic component common to many forms of trauma, such as tumbling, hemorrhage, electric shock, ionizing irradiation, or other stimuli, may be indicated. (BBB)

34806 RADIATION DEATH IN ANIMALS. RELATIONSHIP BETWEEN LETHAL EFFECTS ON ANIMALS AND CELL DEATH. Egami, Nobuo (National Inst. of Radiological Sciences, Chiba, Japan). Kagaku (Tokyo), 36: 140-6(Mar. 1966). (In Japanese).

It is pointed out that radiation doses to critical organs are important in acute radiation deaths in lower vertebrates as well as in mammals. The relation between the period of survival after exposure to x rays and the dose of radiation was studied in goldfish and other teleost fishes. The dose-survival time curves for fishes are very similar in shape to mammals, and hematopoietic, intestinal, and brain deaths are clearly distinguishable from these curves. In fish, the length of survival time varies with the post-irradiation temperature. Cell population kinetics with ^{3}H-thymidine in critical organs were studied at different temperatures, and the relation between the length of generation time of critical cells and the survival period of the fish is discussed. (NSA of Japan)

34807 MODIFICATION OF BREAKAGE AND REUNION IN RELATION TO LETHAL DAMAGE. de Lozzio, Carmen B.; Valencia, Juan I. (Univ., Buenos Aires). Nat. Cancer Inst. Mongr., No. 18, 181-212(Dec. 1965).

Modifications induced by metabolic inhibitors, given before or after x irradiation, on mitotic delay, chromosome breakage, and cell lethality were studied in ELD Ehrlich ascites tumor. The generation time of this tumor is 28 hr. G_2 lasts 6 hr, S is about 13 to 15 hr, G_1 is about 6 to 8 hr, and the mitotic time is 0.75 hr. After irradiation with 500 R, a mitotic delay of 6 hr, mainly due to a block in G_2, was found. Fluorodeoxyuridine (FUDR) alone prolonged the time of S, did not delay G_2, and the combined treatment (FUDR plus 500 R) induced both a block in G_2 and prolongation of S. Chloramphenicol or sodium azide alone delayed the cells in G_2, but did not increase significantly the mitotic delay over that induced by x rays alone. Chromosome breakage induced by 500 R was increased by pretreatments or posttreatments with inhibitors, depending on the stage of the cell cycle. Lethal damage was also increased by some inhibitors, but this effect was not always seen in the same stage of the cell cycle at which increased breakage was observed. When the dose of x rays was 500 R, none of the inhibitors tested modified the percentage of tumor takes in the animals, but the cell population decreased in the first hours after irradiation. With 500 R, pretreatment with sodium azide killed cells mainly from S, chloramphenicol damaged cells from G_2 and perhaps from G_1, and posttreatment with FUDR was lethal for many cells from G_2 and S. When the inhibitors were used with 200 R, pretreatment with sodium azide and the combined pretreatment and posttreatment with chloramphenicol killed the entire cell population. FUDR given at high concentration after irradiation damaged most cells and tumor growth was inhibited in 80% of the animals. This last effect was not reversed by thymidine or uridine and therefore was not due to inhibition of DNA or RNA synthesis. It is postulated that mitotic delay, chromosome breakage, and cell lethality are 3 independent processes not produced by the same mechanism. It also concluded that the lethal damage induced in a cell population is due only in part to chromosome damage, and that another part is caused by the inactivation of other target molecules, related or not to DNA synthesis. (BBB)

34808 MEDICAL AND SURGICAL USES FOR THE LASER. Goldman, Leon (Univ. of Cincinnati). New Sci., 21: 284-6 (Jan. 30, 1964).

Some effects of laser radiation on animal tissues, cells, and cell components are reviewed. With low-energy lasers, emitting 1 J or less, very little reaction is produced on the skin of a white person. As the laser energy is increased, however, significant changes take place, both in the skin and in the superficial blood vessels. Eventually, cells are destroyed by their absorption of laser energy. Use of this destructive property of the laser to treat various types of skin lesions is described. With increases of the output energy, most destructive changes are wrought in tissue, though the area affected remains small; with an unfocused laser beam it may measure 1 to 2 cm across, and with a focused beam from about 1 mm to 0.01 mm. With fresh and dried films of blood, changes were produced in red cells and white cells, confirming that, even in transparent bodies, changes can be produced by the laser. Studies were also made of laser exposure of fresh tissue and even of cultures of tissue and of human chromosomes. Lasers attached to microscopes can perform microsurgery on cellular elements such as mitochondia, portions of the nucleus, or chromosomes. The major cause of laser reaction in tissue is that of a local absorption of intense heat. The brief period of impact, 1 msec or less, may prevent this thermal action from spreading to other areas. (BBB)

34809 THE RELATIONSHIP BETWEEN THE OXYGEN CONSUMPTION OF VARIOUS TISSUES AND THE RADIOSENSITIVITY IN MICE. 3. THE RELATIONSHIP BETWEEN THE OXYGEN CONSUMPTION OF VARIOUS TISSUES AND THE THYROID FUNCTION IN THREE STRAINS OF MICE. Tsuchiya, Takehiko (National Inst. of Radiological Sciences, Chiba, Japan); Okamoto, Kazuo. Nippon Igaku Hoshasen Gakkai Zasshi, 26: 375-81(July 1966). (In Japanese).

The oxygen consumption was measured in vitro in various tissues (spleen, liver, and kidney) from these strains of mice which had been administered L-thyroxine or Mercazole for one week, or exposed to x rays. L-thyroxine increased oxygen consumption in C57BL/6 mice, but decreased it in CF#1 and RF mice. On the other hand, Mercazole decreased it in all three strains, among which the degree of decrease was lower in C57BL/6 than in other strains. The sensitizing effect with L-thyroxine to radiation was observed in C57BL/6 mice, but not in both strains of CF#1 and RF mice. On the contrary, Mercazole showed some degree of protective effect in three strains of mice. These results indicate that radiosensitivity has a certain relation with thyroid function, by which oxygen consumption is modified. (NSA of Japan)

34810 SOME EFFECTS OF ACUTE ^{60}Co GAMMA RADIATION ON FOUR DEVELOPMENTAL STAGES OF THE BRINE SHRIMP ARTEMIA SALINA (L.). Boswell, James Louis. College Station, Tex., Texas A and M Univ., 1966. 88p.
Thesis.

Special developmental stages of Artemia salina (L.) were exposed to graded doses of gamma radiation, ranging from 0 to 200 kR, and maintained in a seawater culture medium containing 5% NaCl. Light was kept constant at 200 ± 10 foot candles and temperature maintained at 26° ± 2°. The hatchability of the cyst (blastula) stage was not affected when irradiated, after soaking in seawater, with doses of up to 75 kR. Reduction in hatchability of wet cysts treated at the 100 kR level was doubtfully significant ($P < 0.1$). An explanation, based on the relative activity of the nuclei and the extent of their dispersion within the cyst, was offered to explain the extreme radioresistance of partially hydrated cysts.

Reduction in total length of larvae hatched from irradiated cysts was found to be significant at the 1% level and linear with dose. Differences in the group means of width/length ratios of larvae treated in stage 0 at dose levels of up to 20 kR were significant and linear with dose. The threshold value for eye abnormalities in larvae irradiated in the cyst stage was found to be between 25 and 50 kR. Eye defects occurred at most dose levels up to 100 kR in larvae treated in stage 0. Development of genitalia was not affected in larvae irradiated with doses up to 100 kR, at a time coincident with the appearance of the genital anlage. Lethal dose survival curves for larvae irradiated in the cyst stage and in stage 0 were sigmoidal. Cumulative mortality curves for stage 12 shrimp exposed to dose levels between 25 and 100 kR, and stage 19 (adult) shrimp exposed to dose levels of 25 to 200 kR were sigmoidal at the lower dose levels, approaching linear at the highest levels. The threshold-lethal dose for all larvae treated at stage 0 was found to be between 10 and 15 kR. Adult males showed a greater radioresistance at the higher dose levels than adult females. Changes in radiosensitivity were most drastic between 175 and 180 kR for males and between 160 and 175 kR for females. The LD_{50} 1-day doses were found to be 180 kR for adult males and 175 kR for adult females. Of the four developmental stages treated, stage 19 was most resistant to radiation. Stage 0 was least resistant. LD_{50} and LD_{100} doses for various time periods were tabulated for the four developmental stages treated. Mitotic activity in the blood-cell-forming organs of adults was arrested by doses of 100 to 175 kR, preventing replacement of cells contributed to the blood stream. Reduction in size of the blood-cell-forming organs of shrimp treated at these dose levels was found to be highly significant as compared to controls, $P < 0.001$. Animals treated at 200 kR died before measurable reduction of these organs occurred. Mating activity declined in direct proportion to dose level. Dose rates of up to 100 kR apparently had no effect on the molting rate of stage 0 larvae. Approximately 1 molt/day was recorded for each larva for up to 7 days or until death of the individual. Presumably radiation damage to the experimental animals was accomplished through the mechanism of direct hits on mitotically active nuclei, e.g., mesoderm cells, and on the interphase nuclei of the phagocytic storage cells. Radical formation was believed to have caused metabolic imbalance resulting in death, particularly in adults. Suggestions for the direction of future research were given. The test was illustrated by 11 tables and 28 figures. (Disser. Abstr.)

34811 VOPROSY VLIYANIYA IONIZIRUYUSHCHEGO IZLUCHENIYA NA SERDECHNO-SOSUDISTUYU SISTEMU. (Problems of Ionizing Radiation Effects on the Cardio-Vascular System). Nadareishvili, K. Sh. Tbilisi, USSR, Izdatel'stvo Metsniereba, 1966. 298p.

Literature data and experimental results on the effects of ionizing radiation on the cardio-vascular system and the regulatory mechanism in hemodynamics in humans and animals are reported. Particular attention is given to the initiation of the pathogenic changes and any disturbances of the hemodynamics caused in the irradiation process and to organism, cellular, and molecular mechanism of radiation disturbances in blood formation. Methods for the complex recording of a series of physiological and clinical tests and for the determination of different hemodynamic indicators are also given. (tr-auth)

34812 EARLY BEHAVIOR IN THE DOMESTIC CHICK AS A FUNCTION OF EMBRYONIC X-IRRADIATION. Strobel, Michael Gustav. Toronto, Univ. of Toronto, 1966.

Thesis.

The approach and following response of neonate chickens is generally assumed to be indicative of imprinting processes. The effects of embryonic x irradiation on the topographically defined approach response were studied in view of the implications for the ontogeny of behavior. In particular the development of feeding and flocking behavior was examined. The parameters of embryological age at which x-ray treatment was effective were investigated on groups of 10 subjects, irradiated with 400 R on day 5, 7, 9, and 12 of incubation. After hatching the chicks approached an intermittent light and sound pattern. Disturbance of the response was only apparent in the day 7 group, and to a lesser degree in the day 9 group. The observed disturbance consisted in a lack of integration of the approach response into a persistent behavior pattern with ensuing loss of predictability of the behavior. It was ascertained that the x-ray effect was not merely due to sensory input deficit or effector damage. When forced to execute the approach response under muscular strain by running uphill on an inclined plane of 30°, no difference in speed and reaction time was found between irradiated and control subjects. However the tendency toward erratic behavior remained visible. It was concluded that a central mechanism was implicated. The x-ray effect measured by approach latencies was found to be nearly a linear function of delivered dose over the range tested. Groups of 10 subjects were irradiated on day seven with 24R, 72R, 174R, and 318R. An increasing number of subjects was affected, and the affected subjects showed aggravated disturbances with ascending dosage levels. A statistical model was proposed to explain the results. An attempt was made to obtain evidence of the x-ray effect directly on the CNS. Antigenic brain components were scrutinized for qualitative and quantitative changes by immunological analysis. Precipitin reactions observed with the agar gel diffusion technique pointed toward a modified saline-soluble brain protein component. It is believed that DNA-RNA protein synthesis is implicated in the irradiation effects. The trophodynamic behavior system that involves approach to food stimuli was not affected by x irradiation on day seven of incubation. A pecking induction stimulus was developed that had the property of inducing pecking in neonate chicks and which sustained pecking at an object different from the inducer stimulus. Similarly no effect was noted on the pecking behavior. Aggregative behavior, maintained by approach to stimuli emanating from conspecifics, was severely affected by irradiation during the sensitive period. Groups of 10 subjects were tested for approaching a flock on either visual or auditory cue. The disturbing treatment effect was particularly apparent on chicks raised communally and presumably imprinted upon each other. The effect was still visible on chicks raised in isolation and observed while imprinting processes could have taken place. It was finally concluded that x irradiation at the radiosensitive embryonic stage has a disorganizing effect on the imprinting processes and affects especially social behavior. (Dissertation Abstr.)

Radiation Effects on Plants

Refer also to abstracts 34565, 34611, 34642, 34643, and 34645.

34813 CONTRIBUTION TO THE PROBLEM OF REGENERATION OF LIVE ORGANISMS FOLLOWING THE ACTION OF IONIZING RADIATION. IV. ACTION OF SOME BIOCATALYSTS ON THE CROP OF SOYABEAN UNRADIATED AND RADIATED WITH X-RAYS. Cerkovnikov, Eugen; Steiner, Aleksa; Kirigin, M. (Univ. of Zagreb, Croatia, Yugoslavia). Acta Pharm. Jugoslav., 15: 127-37(1965).

The radioprotective effects of hormones such as phenylmercaptoacetic acid on soybean seeds were investigated after exposure to 2, 20, and 100 kR doses of x rays. The use of biocatalysts moderated the inhibitory effects of radiation and resulted in crops with increased yields. (H.G.D.)

34814 SIGNIFICANCE OF THE CONDITIONS OF CULTIVATION IN THE RADIORESISTANCE OF PLANTS. Nazirov, N. N. Radiobiologiya, 6: 904-7(1966). (In Russian).

Air-dried seeds of wild grasses from various zones of Uzbek and Tadzhik SSR were subjected to γ irradiation at doses from 3 to 100 kR, and cotton seeds from various regions of Central Asia were γ irradiated at doses from 2 to 20 kR at a dose rate of 25 R/sec, one to two days before planting. Distinct regional variations in the radiosensitivity were observed, corroborating the hypothesis of a strong influence of the conditions of cultivation of plants upon radiosensitivity. (JPRS)

34815 THE EFFECT OF SULFUR-CONTAINING ANALOGS OF SUGAR DERIVATIVES ON PLANT GROWTH AND METABOLISM. III. STUDY OF THE EFFECT OF γ RADIATION ON THE FREE AMINO ACID AND CARBOHYDRATE CONTENT IN THE GERMINATING PEA PLANTS IN THE PRESENCE OF 1-THIO-D-GLUCOSE. Jiracek, Vladimir; Karlova, Marie; Kocourek, Jan (Karlova Univ., Prague). Rostlinna Vyroba, 37: 1001-18 (1964). (In Czech.)

The content of carbohydrate and free amino acid in the cotyledons, roots, and stalks of pea plants that developed from seeds given 250 to 1000 R doses of γ radiation was determined over a 14-day period. Seeds were irradiated in the dry state or after they were soaked in an aqueous solution of 1-thioglucose (10^{-4} M). In general, the irradiation of the pea seeds provoked growth reactions and produced changes in the carbohydrate and free amino acid content. The modifications were slightly affected by the 1-thioglucose; the 1-thioglucose offered no protective effect against the radiation doses that inhibited growth. Of the carbohydrates, the contents of glucose, fructose, and X_3 (a substance that was not identified but believed to be a glycopeptide) were principally modified. With respect to the amino acids, it was principally the basic content of free amino acids and the content of amino acids that are closely associated with carbohydrate metabolism that were most affected by the irradiation. (B.N.S.)

34816 THE INFLUENCE OF γ-RADIATION ON THE STRUCTURE OF PLANT YIELDS. Bogdashevskaya, O. V.; Runova, Yu. N.; Panarin, V. P.; Prokhorova, L. S. (Inst. of Biological

Physics, Moscow). Radiobiologiya, 7: 281-4(1967). (In Russian).

The influence of γ-radiation on the growth of individual plant organs and on the plant yield was investigated on Petkus spring rye. Air-dried seeds were irradiated at a rate of 700 R/min doses of 1, 2.5, and 5 kR and sown ten days later. The increment obtained from the 1 kR sowing consisted of above-ground growth. Irradiation with 2.5 and 5 kR doses stimulated mainly the underground organs. (JPRS)

34817 INFLUENCE OF RADIOACTIVE CONTAMINATION OF THE SOIL ON PINE AND SPRUCE SEEDINGS. Karaban, R. T.; Tikhomirov, F. A. (Inst. of Applied Geophysics, Moscow). Radiobiologiya, 7: 275-80(1967). (In Russian).

Seedlings of pine (Pinus silvestris) and spruce (Picea excelsa) in boxes were artificially contaminated with Sr-90 + Y-90 solution at levels of 0.3, 2.6, and 5.2 $\mu Ci/m^2$ and placed in natural conditions for two years, after which the boxes were removed. At contamination levels above 2 μCi the growth of the seedlings was noticeably depressed in the second year; some of the upper roots died and the lower, less contaminated, roots grew more intensively. Spruce needles accumulated the radioisotopes ten times more strongly than pine needles. (JPRS)

34818 RADIATION-INDUCED DWARF MUTANT IN BARLEY. Krishnaswami, R. (Indian Agricultural Research Inst., Delhi). Curr. Sci. (India), 36: 327-8(June 20, 1967).

True breeding, recessive, dwarf mutants were isolated in barley after 30 kR x-ray treatment. The height of the mutant was reduced, the number of ear-bearing tillers in the dwarfs was more than in the controls, and the number of internodes per tiller was less in these mutants. In other features such as heading time and maturity, the mutant was similar to the control. The seed-set of the mutant was much improved. (B.L.M.)

34819 SUPERIOR RADIORESISTANCE OF POLYPLOIDS: A TOOL FOR THE PREFERENTIAL ELIMINATION OF DIPLOID CELLS IN A COLCHICINE-INDUCED MIXOPLOID TISSUE. Siddiq, E. A.; Swaminathan, M. S. (Indian Agricultural Research Inst., New Delhi). Curr. Sci. (India), 36: 307-8(June 20, 1967).

Four-day old colchicine-treated maize seedlings having a high frequency of polyploid cells were subjected to LD 50 doses of γ radiation. Analysis of squash preparations of the seedlings fixed at different intervals showed a sharp rise in the frequency of polyploid cells. Sections of the shoot apex of treated seedlings revealed completely enlarged cells. These results provide evidence that intrasomatic selection in favor of diploid cells in a diploid-polyploid chimera could successfully be arrested through suitable radiation treatment. (B.L.M.)

34820 EFFECT OF UV RADIATION ON THE AUXIN-AUXINOXIDASE-PHENOL COMPLEX AND ON THE SENSITIVITY OF PLANT TISSUES TO INDOLEACETIC ACID. Garay, A. S.; Sagi, F. (Inst. of Plant Breeding, Fertod, Hungary). Physiol. Plant., 15: 194-9(1962).

Ultraviolet radiation was found to inhibit the growth of Lupinus albus seedlings. The phenol content of uv-irradiated lupine hypocotyls was increased and simultaneously the auxin oxidase was activated. These changes took place a few days after irradiation with 2600-Å uv light. Irradiation did not change the tissue level of growth stimulators and inhibitors, however. The sensitivity of irradiated tissues to auxin decreased, and this change of auxin sensitivity could be observed immediately upon irradiation and seemed to be primary site of action of uv light. The inhibition of growth due to uv irradiation is explained by the decreased auxin sensitivity of the tissues. The amount of phenolic activators of indoleacetic acid oxidase may be responsible for the enhanced enzyme activity. The validity of this concept could not be tested by direct experiments as, in contrast to the leaf extracts, the dialyzed homogenates of hypocotyls did not oxidize indoleacetic acid even if 2,4-dichlorophenol was added to the system. The stimulatory effect of uv radiation on phenol synthesis has been observed in other experiments. (BBB)

Radiation Effects on Microorganisms

Refer also to abstracts 34587, 34713, 34847, and 34852.

34821 (NYO-2804-10) BASIC ASPECTS OF THE ACTION OF RADIATION ON MICROORGANISMS. Progress Report. Pollard, Ernest C. (Pennsylvania State Univ., University Park. Dept. of Biophysics). July 7, 1967. Contract AT(30-1)-2804. 83p. DTIE.

Results are summarized from a series of studies on the effects of ionizing radiations (γ, x, and fast charged particles) on bacteria. It is concluded that radiation acts on an organized structure in which the bacterial DNA is processed through replication and transcription and that the primary lesion involves a crosslink in the DNA which causes rapid DNA degradation, probably induced by the altered action of the transcription enzyme. Most of the degraded DNA is ejected from the cell, together with some degraded messenger RNA which results from cessation of the transcription process. All of these effects are dependent on the presence of oxygen in the medium and may be altered by the presence of hydrogen peroxide and organic peroxides in the irradiated medium. Data are included from studies on the effects of ionization within the cell on the progeny of single cells; the effects of radiation on DNA synthesis, transcription, respiration, and lipid formation; the nature of the enzyme responsible for degradation of DNA; the possibility of sequential gene degradation; and the nature of the primary lesion. Information on radiation effects on bacteria analogous to mammalian cells is tabulated. A list is included of 62 publications during the period covered by this report. (C.H.)

34822 INACTIVATION OF PHAGE α BY SINGLE-STRAND BREAKAGE. Freifelder, David (Brandeis Univ., Waltham, Mass.). Virology, 30: 328-32(Nov. 1966).

Bacillus megaterium phage α was more sensitive to x irradiation than a typical phage of its size containing double-stranded DNA. Double-strand breakage accounted for only a small part of the inactivation in contrast with many other phages. Ultracentrifuge assay was used to measure single strand breakage in the DNA of the x-irradiated phages. The inactivating event was apparently a single-strand break; however, not all single-strand breaks were lethal. Two alternatives are possible: a break is lethal only if it occurs in a particular strand; or only one strand can function in the cell, and this strand is selected at random. These alternatives could not be distinguished by the experiments described. (BBB)

34823 TRANSDUCTION STUDIES ON THE ROLE OF A rec^+ GENE IN THE ULTRAVIOLET INDUCTION OF PROPHAGE LAMBDA. Hertman, Israel; Luria, S. E. (Massachusetts Inst. of Tech., Cambridge). J. Mol. Biol., 23: 117-33(1967).

The rec^+ gene was introduced into Escherichia coli K12 rec^- mutant bacteria by transduction with phage P1. Both abortive and complete transduction occurred at frequencies of 2×10^{-4} and 2×10^{-5} per adsorbed P1, respectively. Transduction of the rec^+ gene to rec^- λ^5 bacteria was shown by an increased resistance to uv light; transduction to rec^- (λ) bacteria results in the appearance of the capacity to produce λ phage after uv irradiation. Analysis of the causes for the failure of rec^- (λ) bacteria to produce λ phage after uv treatment indicated that, in the absence of the rec^+ gene, the immunity repressor remains active after irradiation. The effect of uv light persists, however, and can be revealed even after 2 hr by introduction of the rec^+ gene. Implications of these findings for the mechanisms of prophage induction by uv light are discussed. (BBB)

34824 MACROMOLECULAR SYNTHESIS AND DELAYED MITOTIC DEATH DUE TO RADIATION AND DRUGS IN CHLAMYDOMONAS AND CHLORELLA. Jacobson, Baruch S.; Lee, Theresa C. (Univ. of Minnesota, Minneapolis). Contract AT(11-1)-1117. Radiat. Res., 31: 368-81(July 1967).

Chlamydomonas reinhardi and Chlorella ellipsoidea reproduce through mitotic cycles characterized by a long growth period followed by two or more divisions in rapid succession. At least four daughters are produced per division cycle. In both algae, irradiation or plating on actinomycin D (AMD) agar results in a blockade of the cycle in the single-cell stage. Most cells undergo a complete cycle before this occurs. Colonies growing on dithiodiglycol agar are frequently arrested in the two-cell stage. The incorporation of inorganic phosphate into Chlamydomonas DNA is not inhibited by γ irradiation or by AMD. Incorporation of ^{14}C into DNA from CO_2 was increased in the presence of AMD. Labeling of protein was relatively unaffected. The rate of incorporation of ^{14}C into RNA was correlated with the cell count, which increased most rapidly in the controls. Under the conditions tested, chloramphenicol, which produces a similar mitotic block, inhibited ^{14}C incorporation into all three fractions. The critical stage in the division cycle, at which effects of AMD, chloramphenicol, or previously incurred radiation damage are expressed, is probably the period immediately prior to the first mitosis of the cycle. (auth)

34825 LACK OF X-RAY-INDUCED LETHAL SECTORING IN HAPLOID SACCHAROMYCES. Haefner, K. (Southwest Center for Advanced Studies, Dallas). Radiat. Res., 31: 400-7 (July 1967).

In contrast to results reported for haploid, diploid, and tetraploid Saccharomyces at x radiation doses of about 40 kRADs, no lethal sectoring was found for haploid and diploid Saccharomyces for doses below 12 kRADs. The importance of these results in respect to the interpretation of lethal sectoring is discussed. Some

conclusions are drawn from the data which favor the idea that recessive lethal mutations are of minor importance for the inactivation of haploid Saccharomyces strains. (auth)

34826 THE ISOLATION OF ULTRAVIOLET SENSITIVE MUTANTS FROM ASPERGILLUS RUGULOSUS. Lennox, J. E.; Tuveson, R. W. (Univ. of Chicago). Radiat. Res., 31: 382-8 (July 1967).

Four mutants selected for sensitivity to ultraviolet light in Aspergillus rugulosus exhibit cross sensitivity to $NaNO_2$. The results of a cross between one of the uv-sensitive mutants (uvs-4) and a strain exhibiting normal sensitivity can be interpreted by assuming that the mutant resulted from the alteration of a nuclear gene. The results also imply that uv sensitivity is correlated with conidial pigmentation. $NaNO_2$ sensitivity appears to be independent of conidial pigmentation. (auth)

34827 TEMPERATURE DEPENDENCE AND EFFECTS OF GLYCEROL ON THE RADIATION SENSITIVITY OF BACTERIOPHAGE–ESCHERICHIA COLI COMPLEXES RELATED TO DIRECT AND INDIRECT RADIATION EFFECTS. Shalek, Robert J.; Smith, Charles E.; Hunter, Jerry (Univ. of Texas, Houston). Radiat. Res., 31: 467-85(July 1967). (ORO-2832-45).

A test system of T2r bacteriophage DNA injected into the Escherichia coli host (1- or 2-minute development at 37°C) permitted experimentation with biologically active DNA in a cellular environment. By irradiation of this system in the liquid and frozen state with cobalt-60 γ rays at various temperatures, an estimate of the contribution of direct and indirect radiation effect was made. It was concluded that not more than 33% and perhaps as low as 15 to 20% of the radiation effect on T2r DNA in a host bacterium is by direct radiation effect; the remainder is by indirect effect. Percentages of the same magnitude were found for irradiations in air and in nitrogen. An oxygen effect of 1.6 was found in the liquid state and the frozen state. The addition of 1M glycerol (in air) confers radiation protection in the liquid and the frozen state. The protection is threefold at 0°C and about 35% at –160°C. The activation energy derived for frozen phage–bacterial complex in 1M glycerol is similar to that found for dried enzymes and bacterial spores. (auth)

34828 ULTRAVIOLET PHOTOINACTIVATION STUDIES ON HYBRID VIRUSES OBTAINED BY THE CROSS-RECONSTITUTION OF THE PROTEIN AND RNA COMPONENTS OF U(1) AND U(2) STRAINS OF TMV. Streeter, David G.; Gordon, Milton P. (Univ. of Washington, Seattle). Photochem. Photobiol., 6: 413-21(June 1967).

The uv-radiosensitivity of tobacco mosaic virus (TMV) and the determination of the structural component primarily responsible for this property in the intact virus are reported. A comparison of the uv inactivation kinetics, at 253.7 nm of the common (U(1)) TMV strain and the mild (U(2)) strain confirmed that the latter was about six times more sensitive. The sensitivities of the two TMV strains to uv-inactivation were compared with those of hybrid viruses obtained by reconstituting the protein of either native strain with the RNA of the other. In each case, the hybrid virus was found to be virtually identical in sensitivity to the native strain that supplied the protein coat. This indicated that the relative uv-sensitivities of the two native strains were solely a function of their respective protein coats. Amino acid analysis of the U(2) protein revealed about 13 or 14 amino acid replacements as compared with the U(1) strain. Results were in agreement with earlier studies that indicated that there were considerable differences in the protein subunits of the two protein coats. Some ways in which the observed differences in proteins of the two strains may determine the respective uv-sensitivities are discussed. (BBB)

34829 MUTATION IN COLLETOTRICHUM FALCATUM WENT, THE CAUSAL ORGANISM OF RED ROT OF SUGARCANE. IV. MORPHOLOGICAL AND BIOCHEMICAL MUTANTS INDUCED BY IONIZING RADIATION. Bajaj, B. S.; Chatrath, M. S.; Vasudeva, R. S. (Indian Agricultural Research Inst., New Delhi). Indian Phytopathol., 17: 296-303(1964).

A number of biochemical and morphological mutants of Colletotrichum falcatum Went were obtained using different kinds of ionizing radiations: ^{32}P, β-particles, fast neutrons, γ-rays (^{60}Co and radon gas), and x rays. Irradiation of cultures with fast neutrons, γ rays, and x rays did not yield appreciable results; most of the morphological mutations and all of the biochemical mutations that were observed were induced by means of ^{32}P-irradiation during growth phase. Biochemical mutants showed deficiencies for one or several vitamins of the B-vitamin group and a wide range of morphological variability; however, no correlation appeared to exist between the nature of the deficiency and the morphological character. It was concluded that β particles were highly mutagenic in C. falcatum. (B.H.S.)

34830 THE SURVIVAL OF SOIL MICROORGANISMS UPON γ IRRADIATION OF THE SOIL. Kashkina, G. B.; Abaturov, Yu. D. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 7: 263-6(1967). (In Russian).

Moist and dry soils were irradiated with doses of 2.5 to 1000 kR to investigate the resistance of bacteria, actinomycetes and fungi. Bacteria were the most resistant; their spores were detected at a dose of 1000 kR. Fungi were the most sensitive, even to a dose of 2.5 kR; after a dose of 250 kR their quantity was tenths of a percent of that of the control. Actinomycetes occupied a middle position, not being completely destroyed at 625 kR. All groups withstood a much larger dose in dry soil than in moist. Substantial qualitative changes occurred in bacteria at 250 kR or more and in fungi at 125 kR or more. (JPRS)

34831 QUANTITATIVE ESTIMATION OF YEAST CELL RECOVERY FROM LETHAL RADIATION. Kapul'tsevich, Yu. G.; Petin, V. G. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 7: 258-62(1967). (In Russian).

Suspensions of strain Megri-139-v of Saccharomyces vini were lethally irradiated and incubated five days at 30° in wort agar. Measurements of the quantities of cells in three classes (those surviving and those capable of forming colonies of 5 to 40 and 2 to 4 individuals respectively) revealed that the recovery of the cells is a function of the decrease of the effective dose and can be expressed quantitatively as $R = 1 - (D_{eff}/D_0)$. (JPRS)

34832 CORRELATION OF THE VIABILITY OF UNIRRADIATED AND IRRADIATED E. COLI B BACTERIA GROWING IN DIFFERENT NUTRIENT MEDIA. Myasnik, M. N.; Korogodin, V. I. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiologiya, 7: 247-50(1967). (In Russian).

Unirradiated and irradiated (10 to 20 kR) colonies of E. coli B growing in different media and at different temperatures were investigated. The results show that the unfavorable nature of the environment is intensified by a factor of 10 to 20 after irradiation, indicating that the selective influence of the medium can have a greater influence than radiation injury on the dependence of viability on conditions. (JPRS)

34833 THE MUTAGENIC EFFECT OF ULTRAVIOLET RADIATION AND NITROUS ACID ON MYCOBACTERIUM PHLEI. Radochova, Miluse; Konicek, J.; Malek, I. (Inst. of Microbiology, Prague). Folia Microbiol. (Prague), 11: 163-8(May 1966).

Lethal and mutagenic effects of nitrous acid and uv radiation on Mycobacterium phlei were studied. Three auxotrophic strains of the PA strain and isoniazid- and streptomycin-resistant mutants were studied. (TSS)

34834 ISOLATION AND PROPERTIES OF A EUGLENA MUTANT RESISTANT TO THE KILLING AND BLEACHING EFFECTS OF N-METHYL-N'-NITRO-N-NITROSOGUANIDINE AND SOME OTHER AGENTS. McCalla, D. R. (McMaster Univ., Hamilton, Ont.). Biochim. Biophys. Acta, 142: 219-27(June 20, 1967).

Euglena gracilis cells were exposed to a high concentration of N-methyl-N'-nitro-N-nitrosoguanidine (NG) and then grown on CO_2 as the sole carbon source. Among the survivors were cells that were 2- to 4-fold resistant to both the bleaching and killing effects of NG. Growth of a typical resistant mutant was inhibited for a shorter time by modest concentrations of NG than was growth of the sensitive, parental Strain z. Likewise, nucleic acid synthesis in the resistant mutant was affected much less strongly than nucleic acid synthesis in Strain z. The results are discussed in terms of the possibility that the NG-resistant cells were better able to repair NG-induced damage. In the resistant mutants, chloroplast-forming ability was cross-resistant to nitrofurantoin but not to ultraviolet light, while colony-forming ability was resistant to both these agents, suggesting that colony-forming ability and chloroplast forming ability had become resistant through independent mutations. In addition, colony-forming ability was resistant to γ-radiation and to nitrogen mustard; agents that do not cause bleaching. Thus the colony-forming ability of NG-resistant Euglena shows a cross-resistance pattern similar to bacterial mutants selected for resistance to radiation or a radiomimetic chemical. (auth)

34835 VIRAL STUDIES OF THE AGENTS OF THE ENZOOTIC PIG PNEUMONIA (STRAIN G). THE ACTION OF CERTAIN PHYSICAL AND CHEMICAL AGENTS ON THE AGENTS OF THE ENZOOTIC PIG PNEUMONIA. Sorodoc, G.; Surdan, C.; Strulovici, D.; Burducea, O.; Copelovici, Yolanda (Inframicrobiological Inst., Bucharest). Rev. Roum. Inframicrobiol., 1: 329-33(1964). (In German).

Mice injected with the Strain G pig pneumonia organism died within four to six days when the virulent suspensions had been

previously incubated for 1 to 4 min at 70°, 20 min at 56°, 7 days at 37°, or 10 days at 22°. Mice injected with suspensions irradiated with uv light for periods of time greater than 30 sec survived, but suspensions irradiated with uv for less than 30 sec retained their virulence. Mice injected with suspensions that had been irradiated previously with 200 to 300 R of x radiation died, but 60% of the mice injected with suspensions irradiated with 100 to 200 R of γ radiation survived the treatment. (BBB)

34836 IN VITRO SUSCEPTIBILITY OF STRAINS OF PENICILLIUM VIRIDICATUM AND ASPERGILLUS FLAVUS TO β-IRRADIATION. Malla, D. S.; Diehl, J. F.; Salunkhe, D. K. (Bundesforschungsandtalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Experientia, 23: 492-3(June 15, 1967).

The effects of β radiation on development of conidia and mycelial growth in seven strains of Penicillium viridicatum and six strains of Aspergillus flavus were determined. Regardless of the specie or strain studied, an increas in the radiation dose increased the retardation of development of conidia and growth of mycelia. Age of the fungi strains played an effective role in susceptibility; conidia of the strains of six-month-old A. flavus and P. viridicatum cultures were more susceptible to irradiation than three-week-old cultures. In general, P. viridicatum cultures were more sensitive to β radiation than those of A. flavus. (B.H.S.)

34837 CHANGES IN X-RAY SENSITIVITY DURING GERMINATION OF PENICILLIUM ATROVENETUM CONIDIOSPORES. Wilson, John Drennan. Urbana, Ill., Univ. of Illinois, 1966. 148p.

Thesis.

The x-ray sensitivity of conidiospores of the fungus Penicillium atrovenetum was measured at various times during different conditions of germination. The radiosensitivity of these spores was found to change markedly during the process as indicated by both qualitative and quantitative changes in the x-ray survival curves. The sensitivity to x-rays progressively increased during the early phases of germination as indicated by increasing slopes of the survival curves; after reaching a maximum, x-ray sensitivity then decreased during the later stages of germination, and the development of a two-component survival curve was observed. The changes in radiosensitivity differed from changes in heat sensitivity also measured during germination; they were correlated with the appearance of specific morphological changes, but could not be correlated with certain biochemical events associated with germination and measured in this study. (Disser. Abstr.)

34838 THE EFFECTS OF IRRADIATED MEDIUM ON SOME CELLULAR FUNCTIONS OF E. COLI. Frey, Harold Earl Jr. University Park, Pa., Pennsylvania State Univ., 1966. 64p.

Thesis.

An investigation of the effect of irradiated growth medium on a strain of Escherichia coli that required thymine and leucine was conducted. Minimal salts medium with glucose as a carbon and energy source was used in all experiments. The medium was exposed to cobalt 60 gamma radiation at a dose rate of 4.7×10^5 R/min. The medium was also bubbled with oxygen prior to irradiation. Initial investigations studied the effect of irradiated medium on the uptake and incorporation of ^{14}C-labeled thymine into the trichloracetic acid insoluble fraction of the cells. In order to extend the study to more general cellular functions, cell growth was examined by measuring optical density and colony forming ability. To study the effects of this unknown agent on the cells, a peroxide assay, metabolic inhibitors, and methylene blue were employed. The results indicated that the damaging agent was a peroxide, quite possibly hydrogen peroxide. Evidence was given that pointed to the damaging of a structure of the cell in either the presence or absence of an energy source. The specific site of the peroxide action appeared to be on the cytochrome chain. (Dissertation Abstr.) (TSS)

34839 MEASUREMENT OF BIOLUMINESCENCE AND CELLULAR RESPIRATION DURING X-RAY EXPOSURE. Jacobson, Arnold Palmer. Ann Arbor, Mich., Univ. of Michigan, 1966. 171p.

Thesis.

It was hypothesized that bacterial luminescence depends on a tenuous balance between the production and oxidation of $FMNH_2$, and that this balance can be altered by chemical and physical treatments, including ionizing radiation. If radiation suppresses luminescence by competing for $FMNH_2$, then cellular respiration should also change during exposure. Apparatus is described that allows continuous observation of bioluminescence during as well as before and after x-ray exposure. A comparison of radiation effects on the luminescence of Photobacterium fischeri is made both in vivo and in vitro. Cellular respiration and oxygen tension are measured before, during, and after irradiation with a polarographic oxygen analyzer. Within one second of exposure to x rays at dose rates between 2 and 7 krads per minute, luminescence is suppressed, rapidly at first, then more slowly. Radiation suppression of luminescence is essentially the same in vivo and in vitro. The observed differences can be attributed to physicochemical and physiological differences between the two systems. Luminescence in vivo is suppressed by radiation-produced hydrogen peroxide, and when this peroxide is inactivated by reaction with cellular material, luminescence recovers. Catalase protection of in vivo luminescence is nearly perfect; in vitro this protection does not occur nor does H_2O_2 mimic radiation. If hydrogen peroxide is responsible for radioinduced suppression of luminescence in vitro the mechanism is different. The increase of cellular oxygen uptake observed in a majority of samples is fleeting and vanishes after exposure. It is shown that this increase is a metabolic phenomenon linked to cytochrome respiration and is probably the result of radioinduced interference with oxidative-phosphorylation. (Dissertation Abstr.)

Radiosterilization and Radiopreservation

Refer also to abstracts 34404, 34748, and 34774.

34840 (NYO-3274-13) BIOCHEMISTRY AND PHYSIOLOGY OF IRRADIATED FRUITS AND VEGETABLES. Annual Technical Progress Report, September 4, 1966–September 3, 1967. Massey, Louis M. Jr. (New York State Agricultural Experiment Station, Geneva. Dept. of Food Science and Technology). May 31, 1967. Contract AT(30-1)-3274. 67p. Dep. CFSTI.

Progress is reported on studies on the effects of γ radiation on the biochemistry and physiology of fruits and vegetables. Data are included from studies on texture changes and changes in in vivo pectin during the storage of irradiated apples; the effects of Ca leaching on the softening of irradiated carrots; glyoxylate metabolism in irradiated carrots; changes in the respiratory pathway in irradiated apples during storage; the effects of γ radiation on intermediary metabolism in lettuce leaves; and the effects of radiation on the permeability of the vacuolar membrane in carrots. Applications of the findings in the extension of the shelf-life of fruits and vegetables by radiation processing are discussed. (C.H.)

34841 (JPRS-41012) CHANGES IN THE PROPERTIES OF FRESH FISH UNDER THE EFFECT OF GAMMA RAYS. Kardashev, A. V.; Korzhova, Yu. A. Translated from Tr. Vses. Nauch.-Issled. Inst. Morsk. Ryb. Khoz. Okeanogr., 45: 15-25(1962). 21p. (TT-67-31654). CFSTI.

Samples of fresh fish placed in glass jars filled with carbon dioxide and vacuum-sealed at atmospheric pressure were irradiated at 0.2 to 2.0 million R. The irradiated samples were stored at 15 to 18°C and at 0 to 5°C. The effects of irradiation on enzyme activity, numbers of microorganisms, organoleptic properties, and the physico-chemical properties were assessed. It was concluded that: at doses of 1.5 to 2.0 million R, the fresh fish was rendered practically sterile; enzymes were not inactivated and that autolytic processes took place during the time of storage; the time of storage of irradiated fish was 2 wks to 3 mo; the organoleptic properties were somewhat changed since a change in color, shrinkage of the flesh, and a strange smell and aftertaste occurred; and that irradiation provoked changes in the globulin content, flesh consistency, lipid content, and pH. (B.H.S.)

34842 IONIZING IRRADIATION OF MARINE FISH AND MARINE FISH PRODUCTS IN GERMANY. Wittfogel, H. (Staatliches Veterinaeruntersuchungsamts Stade, Cuxhaven, Ger.). Arch. Lebensmittelhyg., 16: 227-9(Oct. 1965). (In German).

Storage tests on codfish filets packed in dried plastic containers showed that filets treated with γ radiation in doses of 75,000 R and storage under refrigeration at 4°C had ~11 days more storagability than unirradiated control filets that could be stored for only 10 days. The irradiated filets could be safely stored for 21 days without noticeable evidence of any change in their appearance, odor, taste, or texture. When doses higher than 75,000 R were used the filets became unpalatable as a result of development of a burned, unpleasant odor and flavor. No tests were made as to whether the protein was damaged by irradiation, or whether the nutritional value of the fish was reduced, and if they were at all toxic, carcinogenic, or if other components were produced in the irradiated product. Bismarck herring in oil in plastic containers and irradiated with 25,000 to 200,000 R at room temperature of 18°C lasted only 2 to 4 days longer than unirradiated controls. The herring that were irradiated with more than 75,000 R developed such strong odors and taste that they were unmarketable. The taste of the herring irradiated with 75,000 R had an improved flavor, but even with the 2 to 4 day storagability increase the costs were too high to make the procedure economically feasible.

When sea salmon were irradiated with 50,000 R, the storagability at room temperature was not increased and above 50,000 R irradiation produced objectionable changes in odor, flavor, and coloration. (BBB)

34843 APPLICATION OF IONIZING RADIATION TO THE STERILIZATION OF DRUGS, BIOLOGICAL PRODUCTS, AND THERAPEUTICAL INSTRUMENTS. Antony, Ferenc. Orv. Hetil., 107: 1216-18(June 26, 1966). (In Hungarian).

The sterilization of drugs, biological products, and medical instruments with ionizing radiation is reviewed. (JPRS)

34844 TOXICOLOGICAL SAFETY OF IRRADIATED FOODS. Kraybill, H. F. (Food and Drug Administration, Washington, D. C.); Whitehair, L. A. Annu. Rev. Pharmacol., 7: 357-80 (1967).

Applications of food irradiation for pasteurization, sterilization, disinfection, disinfestation, and sprout inhibition are reviewed. More detailed potential applications of food irradiation are listed in a table. New and more exacting terms for food irradiation applications recently proposed by an international expert committee are cited. Principles involved in preservation of food by ionizing radiation are discussed, as well as requirements for government supervision and control. Considerations on the effects of radiation on chemical composition and nutritive value are also presented. Methods for evaluation of possible toxicity are outlined. Problems in assessment of potential toxicity and experimental design are examined, and requirements discussed for national and international health legislative control and methods for identification of irradiated foods. The vast amount of data which have been accumulated on numerous types of irradiated foods reveal no evidence of radiation-induced toxicity or carcinogenic effects. However, judgments concerning requirements for toxicological experiments on irradiated foods must continue to be exercised on an individual proposal basis after careful consideration of all evidence. (94 references.) (BBB)

34845 RADIATION-INDUCED OFF-FLAVOR DEVELOPMENT IN WHOLE-EGG MAGMA. Labuza, Theodore P.; Goldblith, Samuel A.; Chandler III, Edward L. (Massachusetts Inst. of Tech., Cambridge). J. Food Sci., 32: 61-3(Jan.-Feb. 1967).

With a ^{60}Co source and a dose rate of 3000 rad/hr, whole-egg magma was irradiated, and the off-flavor threshold intensity was determined in triangular tests by expert taste panels. The dilution technique was employed to show the degree of off-flavor production in the dose range of 50,000 to 400,000 rad at 32°F. The intensity of off-flavor increased at a nonlinear rate. Nitrogen was added to egg magma and blended for 5, 10, and 20 sec prior to irradiation. The threshold doses were determined and compared with whole-egg magma blended for equal times without gas being added. The off-flavor threshold doses with nitrogen added were 47,080, 71,930, and 60,050 rad for 5, 10, and 20 sec, respectively. With normal blending the threshold doses were 38,570, 31,170, and 43,110 rad. A dose response curve was obtained similar to that reported earlier at 80°F. Certain anomalous and inconsistent results obtained on the degree of off-flavor production were attributed to the amount of oxygen present. (BBB)

34846 ROLE OF ATOMIC ENERGY IN INSECT STUDY AND CONTROL. Huque, Heshamul. Agr. Pakistan, 13: 77-80(Dec. 1962).

Uses of radioisotopes and ionizing radiations in entomological research, and particularly in radiosterilization eradication programs, are reviewed. Programs whereby sterilization of insect pests and their complete eradication were achieved by radioisotopes are exemplified by screwworm fly. Consideration is given to use of the sterilized-male method on fruit flies and to the use of ionizing radiation to kill other insects, particularly pests in clothing, packaged foodstuff, and wood products. A device for the control of stored grain pests and the pink boll worm is described. The effect of γ radiation on silkworm cocoons, with reference to technological properties of raw silk, is also discussed. (TSS)

34847 STERILIZATION OF ANTHRAX-CONTAMINATED MINK PELTS BY RADIATION. Snook, G. W.; Kaley, G. S.; Westman, E. R.; McConnell, G. E. (New York State Dept. of Health, Albany). Proc. U. S. Livestock Sanit. Ass., 68: 238-40(Oct. 1964).

Techniques are described for radiosterilization of mink pelts contaminated with Bacillus anthracis spores without damage to the pelts. Results from mass irradiation of pelts are described. Plywood boxes of 120 pelts were submitted to cobalt-60 γ radiation for a period sufficient to give an exposure of 2.5 to 2.6 MRAD. The results suggested that radiation at the levels described may be a practicable and safe method for salvaging mink pellets contaminated with B. anthracis. The cost of this service was considered to be insignificant in comparison to the value of the product. (BBB)

34848 COMPARATIVE STUDY OF THE ACTION OF ^{60}Co GAMMA RAYS AND THERMAL STERILIZATION ON THE CONTENT OF THIAMINE, RIBOFLAVIN, NICOTINIC ACID, AND TOCOPHEROL IN BEEF. Syunyakova, Z. M.; Karpova, I. N. Vop. Pitan., 25: No. 2, 52-5(Mar.-Apr. 1966). (In Russian).

A comparative study was made of the vitamin composition (group B and tocopherol) in beef after its irradiation or heat sterilization. The preparation of the beef test samples for subsequent irradiation and heat sterilization was realized in identical conditions on the same day and from the same raw material. The irradiation of the prepared beef samples with dosages of 6×10^5 and 1.5×10^6 rads was effected through the medium of a 1.6×10^4 R/sec strong Co source, belonging to the All-Union Research Institute of the Canned Goods and Dehydrated Vegetables Industry. Heat sterilization specimens were prepared at an experimental canned goods factory of the Institute. The vitamin composition of the beef test samples was analyzed by using chemical methods. The resultant experimental data demonstrated that the observed decline in the level of the vitamins under study subsequent to irradiation did not exceed the losses secondary to a routine heat sterilization. (auth)

34849 POTENTIALITIES OF RADIOISOTOPES AND RADIATION FOR THE DAIRY INDUSTRY. Kosikowski, F. V. (Cornell Univ., Ithaca, N. Y.). pp 3-13 of STI/PUB-135.

Applications of radioisotopes in dairy technology are discussed. These include the use of ^{14}C and ^{131}I as tracers to study the synthesis of milk fats and proteins; the use of ^{3}H and ^{35}S to promote cheese fermentation and improve cheese flavor; the use of ^{64}Cu in studies of Cu content and oxidized flavor in milk; the use of ^{32}P as a tracer to study the cleanliness of milk contact surfaces; and the use of ^{60}Co and ^{137}Cs for the radiopreservation of milk, especially for the processing of canned evaporated milk and for the pasteurization of the surface of ripened cheese, and in gages for determining the fill of containers. (C.H.)

34850 RESEARCH CONCERNING THE INFLUENCE OF IONIZING RADIATIONS ON THE KEEPING QUALITY OF SUGAR BEETS. Statiscescu, P.; Marseu, P.; Costache, A.; Zamfirescu, M.; Diaconu, T. (Institutul de Cercetari Alimentare, Bucharest). Ind. Aliment., 16: 575-8(Nov. 1965). (In Rumanian).

Attempts were made to prolong the storage time of sugar beet roots by γ irradiation. Doses of 5000, 8000, 10000, and 12000 R were used; beets were stored at 6 to 8°C. Tests were made of the rate of germination, weight changes, and sugar content of irradiated and control beets. Germination was not inhibited entirely by any of the doses used. After a storage period of 125 days the weight loss was 15 to 100% lower after the 5000- and 8000-R doses than that of unirradiated beets. With the same doses the decreases in sugar content were 34.0 to 85.7% less than in control samples. However, sugar content of the beets was lower in the samples receiving 10000 and 12000 R than in the controls. The invert sugar content increased with increasing radiation doses. The quality of the juice of the beets was considered to be greater in the irradiated material. (BBB)

34851 IRRADIATED BLOOD MEAL AND BONEMEAL FOR SLAUGHTER SWINE. Hansen, Villy (Landoekonomisk Forsogslaboratorium, Copenhagen). Landokonom. Forsogslab. Arbog, (Copenhagen): 37-45(1965). (In Danish).

A comparison was made of the physical, chemical, and biological properties of heat- and radiation-sterilized blood and bone meal used as feed for pigs. The heat-treated material was kept at 125°C for 15 min. Radiosterilization was carried out with doses of 5×10^5 to 20×10^5 rad. Both Danish and imported products were examined for contents of protein, nitrogen, ash, and other constituents after heat and radiation treatment. Nutritive values were also determined; on the basis of lysine content (4.11 and 4.44 in heated and irradiated blood meal and 7.52 and 8.57 in bone meal, respectively), it was evident that radiosterilization allowed for greater preservation of essential amino acids. Complete amino acid analyses of the products also revealed higher contents of most nonessential and essential amino acids in both blood and bone meal treated with radiation as compared to that sterilized with heat. Mycological and bacteriological studies revealed the adequate reduction of microorganisms in the irradiated products; mold and bacteria counts fell from 400 to <100 and 80,000 to <100 per g in irradiated blood meal and from 700 to <100 and 65,000 to 3000 per g, respectively, in irradiated bone meal. (BBB)

34852 EMPLOYMENT OF GAMMA RADIATIONS FOR STERILIZING THE CARCASSES OF FOOT-AND-MOUTH DISEASE VIRUS-INFECTED ANIMALS. Baldelli, B.; Begliomin, A.; Frescura, T.; Massa, D. (Istituto Zooprofilattico Sperimentale dell'Umbria e delle Marche, Perugia, Italy). Atti Soc. Ital. Sci. Vet., 19: 538-42(1965). (In Italian).

The possibility of using ionizing radiation for elimination of

the hoof-and-mouth disease virus from domestic animals was investigated. Three pigs were infected intradermally with the virus (type A, C, or O); 40 to 45 hr later (when they manifested the usual symptoms of the disease) they were slaughtered and the carcasses were frozen at −30°C. Samples of blood, lymph nodes, and vertebral bone marrow were irradiated with 0.25- to 2-MRad doses of γ radiation from ^{60}Co. Virus titers in the tissues were then determined in calf kidney cell cultures. Type A and O virus was appreciably decreased in blood after doses of 0.25 Mrad and eliminated after 0.75-Mrad treatment. Type C virus in blood was more resistant and required a dose of 1.75-Mrad for elimination. In general, lower doses were necessary for eradication of the virus from lymph nodes and bone marrow (1.25 Mrad for types C and O, and 0.25 for type A). The results showed that with adequate doses of γ radiation infected carcasses could be made edible. (BBB)

METALS, CERAMICS, AND OTHER MATERIALS

Metals and Alloys

Refer also to abstract 35701.

34853 (ORNL-TM-1733) PRESENT STATUS OF METALLOGRAPHY. Gray, R. J. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 76p. (CONF-660627-16). Dep. CFSTI.

From American Society for Testing and Materials, 69th Annual Meeting, Atlantic City.

Research and development progress is reported on specimen cutting, specimen mounting, specimen polishing, revealing the microstructure, optical microscopy, metallography of radioactive materials, electron and field ion microscopy, metallography and microanalysis, microradiography and autoradiography, quantitative metallography, photography, and metallography training. (M.C.G.)

34854 GUIDE TO UNCOMMON METALS. Simons, E. N. London, Muller Ltd., 1967. 245p. 35s.

The metals covered are: Sb, Ba, Be, Bi, Cd, Cs, Ca, Ce, Cr, Co, Ga, Ge, Hf, In, Ir, La, Li, Mg, Mn, Hg, Mo, Nb, Os, Pd, Pu, Po, K, Ra, Re, Rh, Rb, Ru, Se, Na, Sr, Ta, Te, Tl, Th, Ti, W, U, V, Yb, Y, and Zr. The information given includes, for each metal, its history, principal ores and sources of supply, methods of extraction and production, more commonly required properties, properties less often needed, applications, forms in which obtainable, etc. (UK)

34855 EKSPERIMENTAL'NAYA TEKHNIKA I METODY VYSOKOTEMPERATURNYKH IZMERENII. (Experimental Techniques and Methods of High-Temperature Measurement). Samarin, A. M. (ed.). Moscow, Izdatel'stvo Nauka, 1966. 235p.

Forty-seven articles are included on the theoretical analysis of mechanisms and kinetics of metal oxide reduction reactions, methods for measuring high-temperature melting of metals, and thermocouples for high-temperature measurements. Metal-vapor condensation and elasticity at high temperatures are discussed. One article of special interest was abstracted separately. (R.V.J.)

For an abstract of the individual paper see: 34964.

34856 TUNGSTEN AND ITS COMPOUNDS. Rieck, G. D. New York, Pergamon Press, 1967. 145p. $7.00.

Recent developments and physical, chemical, and metallurgical data about tungsten and its compounds are presented. A compilation of the different theories on the recrystallization of tungsten is included. (D.H.M.)

Corrosion and Erosion

Refer also to abstracts 34250 and 35659.

34857 (BMI-X-434) CORROSION OF CONSTRUCTION MATERIALS IN BOILING 13M NITRIC-0.1M HYDROFLUORIC ACIDS. Miller, Paul D.; Stephan, Elmer F.; Berry, Warren E.; Boyd, Walter K. (Battelle Memorial Inst., Columbus, Ohio). Mar. 30, 1967. 30p. Dep. CFSTI.

Welded and unwelded coupons of candidate constructional materials were exposed to a boiling solution (120°C) of 13M HNO_3 and 0.1M HF for times up to 240 hr. The study was made to aid ORNL in choosing a material of construction for equipment once planned for leaching waste solids from the primary reactor of the Fluidized-Bed Volatility Pilot Plant. HAPO 20 (50 wt % Ni–25 wt % Cr–16 wt % Fe–6 wt % Mo–1 wt % Cu) was the most resistant of the materials studied when the durability of both welds and base metal was considered. Several other alloys showed fairly good resistance to the leach solution, but all were preferentially attacked near, or in, the welded areas; they were Corronel 230 (Ni–36 wt % Cr–5 wt % Fe–1 wt % Cu–1 wt % Mn–1 wt % Ti), Ni–50 wt % Cr, and Haynes 25 (50 wt % Co–20 wt % Cr–15 wt % W–10 wt % Ni–3 wt % Fe–1.5 wt % Mn). Type 309 stainless steel was very susceptible to corrosion at sensitized areas in the heat-affected zones adjacent to welds; after postwelding treatments at 1950°F for 1 hr, no preferential attack at heat-affected zones was found in this alloy. Type 309SCb stainless steel, a Nb-stabilized alloy, corroded at an over-all rate of about 185 mils per month on the basis of weight-change measurements and exhibited knife-line attack; postwelding heat treatments did not effectively reduce the corrosion rate but a treatment for 15 hr at 1950°F reduced the knife-line attack to a negligible amount. The addition of 0.1M $Al(NO_3)_3$ to the leach solution greatly reduced the corrosion of the alloys during a 24-hr exposure. (auth)

34858 (MSAR-67-103) EFFECT OF HIGH TEMPERATURE SODIUM ON AUSTENITIC AND FERRITIC STEELS. MECHANICAL PROPERTIES OF MATERIALS. TOPICAL REPORT NO. 8. RESULTS OF MECHANICAL PROPERTIES TESTS OF 304 SS SPECIMENS CONDUCTED IN: 1. 1200 F SODIUM CONTAMINATED WITH OXYGEN (~300 ppm); 2. 1200 F SODIUM CONTAMINATED WITH CARBON. Andrews, R. C.; Hiltz, R. H.; Kirschler, L. H.; Rodgers, S. J.; Tepper, F. (MSA Research Corp., Evans City, Pa.). July 1967. Contract AT(11-1)-765. 168p. Dep. CFSTI.

The mechanical properties of one heat of 304 ss were measured in two dynamic 1200°F Na systems, one of which was contaminated with carbon and the other which was contaminated with 300 ppM O_2. The effects of the two environments were evaluated by comparing mechanical properties with those in air. Both as-received and 4000-hour exposed materials were tested. Creep, creep-rupture, and fatigue tests were conducted in the flowing Na systems, while tensile tests were conducted in air at both room temperature and test temperature on the exposed material. Impact tests were conducted in air at room temperature. Metallurgical techniques used in post-test evaluation of the specimens and tabs included carbon analyses, microhardness measurements, microprobe analyses, metallographic analyses, standard x-ray diffraction, and chemical analyses of the extracted carbide phases. The effects of sequential exposure of 304 ss to high C and high O_2 were investigated. C increases of 5 Cr-½ Mo, 9 Cr-1 Mo, 304L, 304, 316L, 316, 321, 347 stainless steels, Inconel 600, and Incoloy 800 were measured for four different exposure times. Preliminary use of magnetic traps for removal of contaminants is discussed, as well as the post-test examinations of the piping from the two test loops. Na chemistry and the role it played in characterizing the test medium are discussed with emphasis on C analyses but also including O_2 and emission-spectrograph analyses. The relation of cold-trap temperature with the analyses of Na for O is shown for one of the test loops. (auth)

34859 (N-66-32643) EFFECT OF LOW DENSITY INERT GAS FLUSH ON OXYGEN–COLUMBIUM REACTION AT 1500°F TO 2000°F. Final Report. (Aero Vac Corp., Troy, N. Y.). May 14, 1964. Contract NASw-722. 83p. (NASA-CR-76979). CFSTI.

A process involving a controlled flowing atmosphere to provide a container with the environment desired for testing or processing of materials is investigated. The advantage of this process is cited as its ability to achieve wide ranges of impurity pressures at a minimum of gas flow and equipment cost. Methods for obtaining the desired gas pressure and velocity are described. An analytic expression was derived for the situation where a purge gas has no impurities. The sources of contaminant gases and such factors as surface migration, container outgassing, and tube outgassing were studied. An approximation for impurity concentrations is given. A set of equations was developed to obtain the minimum velocity needed and still attain the required sample concentration, and a furnace was constructed to test a purged system. Nb-1% Zr samples were mounted in the furnace and exposed to the resulting environment at 1500, 1750, and 2000°F for periods of one to ten days. Contaminant level in the samples was compared with the amount gettered in a vacuum system. Examples for application of the process are given. (auth)

34860 GENERAL CORROSION OF INCONEL ALLOY 625 IN SIMULATED SUPERHEAT REACTOR ENVIRONMENT. Pearl, W. L.; Brush, E. G.; Gaul, G. G.; Leistikow, S. (General Electric Co., San Jose, Calif.). Nucl. Appl., 3: 418-32(July 1967).

Inconel alloy 625 fuel-cladding material was corrosion-tested under heat-transfer conditions at metal temperatures up to 1500°F in specially designed out-of-pile superheat facilities. The H_2 and O_2 contents of the steam were controlled to simulate those found in boiling-water-reactor systems. The corrosion data from the 3600-hr heat-transfer tests indicated good corrosion resistance up to the 1500°F metal temperature tested. A compositionally changed layer developed at the metal-oxide interface that appeared to reach a maximum depth at the higher temperatures. The heat-transfer test data indicated that except for a small buildup of oxide during the initial nonlinear transient corrosion period, most of the oxide formed in corrosion was carried down-stream by the superheated steam. The uniform corrosion experienced by the Inconel-625 when exposed isothermally to 1050 and 1150°F for 10,000 hr indicates an initially high-corrosion rate that decreases to a lower constant rate within the first 1000 hr. A small proportion of the total oxide formed was gradually lost to the system. (auth)

34861 ANODIC OXIDATION OF BERYLLIUM. von Krusenstjern, A.; Stiehr, W. (Forschungsinstitut fuer Edelmetalle und

Metallchemie, Schwaebisch Gmuend, Ger. Staatl. Ing.-Schule, Aalen, Ger.). Metall, 21: 692-5(July 1967). (In German).

After a suitable pretreatment Be can be oxidized anodically. The layers formed are of a deep black color. The brilliancy of the layers depends largely on the chemical polishing effect. (tr-auth)

Preparation and Fabrication

Refer also to abstract 34949.

34862 (BNWL-CC-1185) BIBLIOGRAPHY OF ALUMINUM-NICKEL-URANIUM BONDING. Gurwell, W. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 21, 1967. Contract AT(45-1)-1830. 23p. Dep. CFSTI.

This bibliography of 135 references resulted from a search of published literature pertinent to the atomic energy field and was based on Abstracts of Classified Reports, 1953 to April 1967 and Nuclear Science Abstracts, 1951 to April 1967. Only major contributions are included. Some entries are followed by a brief summary to indicate the type or scope of work and any significant results. The references are divided into 6 sections: bonding processes, nickel plates on uranium, bond characteristics and evaluation, Al-Ni diffusion, Ni-U diffusion, and Al-Ni-U and general diffusion. (M.C.G.)

34863 (CEA-R-3248) ELABORATION DE LINGOTS D'URANIUM A PARTIR DE FLUORURES DOUBLES. (Preparation of Uranium Ingots From Double Fluorides). Le Boulbin, Emile (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). May 1967. 55p. (In French). Dep.

Thesis.

A simple method has been developed for the preparation of uranium double fluorides and has given a new impetus to the study of the reduction of these compounds with a view to obtaining very pure uranium ingots. Reduction can be carried out using calcium or magnesium as the reducing agent, this latter metal being very interesting from the practical point of view. A comparative study of the heat balances of the reduction processes for the double fluorides and for uranium tetrafluoride has shown that reduction of the double fluorides is possible. The exact experimental conditions for these reductions have been determined. It was found that the reduction of the double salt UF_4, CaF_2 by magnesium leads to the production of small (20 to 500 g) samples of high-purity uranium with a yield of 99 percent. (auth)

34864 (CEND-3742-311) VANADIUM PURIFICATION. Quarterly Progress Report No. 3, February 1-April 30, 1967. Shen, Y. S.; Worcester, S.; Mahagin, D. E.; Christopher, S. S. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). May 1967. Contract AT(30-1)-3742. 37p. Dep. CFSTI.

A 109 lb ingot of high purity V was processed by commercial melting techniques. Feedstock for the process was vanadium metal produced by aluminothermic reduction of V_2O_5. Two purification methods were employed: double electron beam melting; and double electron beam melting plus an intermediate, Y-doped arc melt. During processing, the metal's quality was determined by analyses of its chemical composition, hardness, and microstructure. In addition to a discussion of each stage of the ingot's production, an evaluation of the entire process is presented. (auth)

34865 (GEMP-67) AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM PROGRESS REPORT NO. 67. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). June 30, 1967. Contract AT(40-1)-2847. 178p. Dep. CFSTI.

Developments are reported for studies on: high-temperature reactor materials; radiation effects on fast reactor cladding and structural materials; refractory metal alloys; physical metallurgy of refractory metal alloys; physico-chemical properties of Fe-Cr-Al-clad fuel elements; advanced long-life reactor fuel cladding and structural materials; radiation effects on heat-resistant metals and alloys; plastic fatigue properties of heat-resistant alloys; advanced pressure vessel materials; physico-chemical properties of clad UO_2 in potential meltdown environments; high-temperature thermocouple and electrical materials; high-temperature carbides for fuel and structural applications. (P.C.H.)

34866 (LA-DC-8605) CHEMICAL VAPOR DEPOSITION OF TUNGSTEN-MOLYBDENUM-RHENIUM TERNARY ALLOY. Fairchild, C. I. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 23p. (CONF-670905-9). Dep. CFSTI.

From Conference on Chemical Vapor Deposition of Refractory Metals, Gatlinburg, Tenn.

Coatings of W-Mo-Re alloy compositions were deposited onto Cu or Mo substrates by the H_2 reduction of mixed WF_6, MoF_6, and ReF_6 gases at temperatures from 550 to 800°C and sub-atmospheric pressures of 10 to 200 torr. The volumetric ratio of H_2 to total fluoride was standardized at 10/1. Alloy compositions studied were in the range 60 to 85 W, 15 to 40 Mo, and 1 to 25 Re. Chemical analyses were used to determine overall and longitudinal compositions and electron microprobe analyses to determine radical concentrations of each element. Microstructural features of the coatings were determined metallographically. The microstructure of alloy deposits changed with deposition temperature from a dense, small grained structure at 600°C to a porous, large grain structure at 800°C. Interruptions in flow or large fluctuations in temperature and pressure caused a clearly defined layered deposit. Electron microprobe examination showed that high concentrations of Mo occurred at some interfaces of the layered structure. Chemical and metallographic analyses indicated that homogeneous, ternary alloy deposits in the range studied can be reproducibly obtained on short cylindrical surfaces (1 to 2 in. long) at 650°C and 10 torr pressure. (auth)

34867 (ORNL-TM-1890) CHEMICAL VAPOR DEPOSITION STATISTICAL PARAMETRIC STUDY. Robinson, W. C.; Patterson, F. H.; Fleming, J. D.; Gorton, C. W. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 24p. (CONF-670905-8). Dep. CFSTI.

From Conference on Chemical Vapor Deposition of Refractory Metals, Gatlinburg, Tenn.

Factors affecting the chemical vapor deposition of W are evaluated in a statistically designed parametric study. Eighty-one experiments were required in the WF_6-H_2 deposition system to provide a third-order polynomial correlation between the response parameters and the independent system parameters over the experimental range of 450 to 820°C, 9 to 20 torr, 60 to 370 cm^3 WF_6 per minute, and 752 to 5240 cm^3 H_2 per minute. The system parameters were H_2/WF_6 ratio, total flow rate, temperature, and pressure. The initial response parameters were determined for an internal deposit in a 15-in. length of a 0.807-in.-ID Cu mandrel. The application and limitations of utilizing the resulting curves for systems of different size and geometry are discussed. The deposition rate of W at HF mole fractions of 0.02, 0.05, 0.10, and 0 20 was also determined for each experiment and correlated with the system parameters. These data in conjunction with theoretical consideration of the system give indications of the rate-controlling process in portions of the experimental range. (auth)

34868 (SCL-DR-67-43) ELECTROPLATING URANIUM WITH NICKEL. Anderson, P. D.; Coronado, P. R. (Sandia Corp., Livermore, Calif.). July 1967. Contract AT(29-1)-789. 35p. Dep. CFSTI.

Development of a process for reliably plating uranium with an adherent protective coating of nickel is reported. A method for evaluating specimens is presented with detailed results. Complete process instructions are given together with experimental data on some effects of deviating from these instructions. (auth)

34869 (SCL-DR-67-44) ELECTROPLATING URANIUM WITH NICKEL. Dini, J. W.; Coronado, P. R. (Sandia Corp., Livermore, Calif.). July 1967. Contract AT(29-1)-789. 22p. Dep. CFSTI.

Supplement to SCL-DR-67-43.

Improvements in the process for reliably plating U with an adherent and protective coat of Ni are given. Specifically, a superior pretreating solution using $NiCl_2$ rather than SnCl is described, as well as a new method for cleaning pieces to be plated. (auth)

34870 (TRG-Report-1446) GAS HYDRIDING ZIRCALOY-2 AT 400°C. Winton, J.; Farrow, M. (United Kingdom Atomic Energy Authority, Culcheth (England). Reactor Group). Feb. 10, 1967. 24p. Dep. CFSTI. UK 3s. 6d.

An account is given of experiments which attempted to develop a method for introducing large quantities of H into Zircaloy-2 samples at a temperature of 400°C over a period of about 3 days. Surface hydride layers could usually be avoided if the rate of ingress of H_2 was kept below 10 ppM/hr, although other factors such as surface contamination were also found to encourage layering. The rate of entry of gaseous H_2 into the Zr surface is controlled largely by the structure and constitution of a thin oxide skin, but no means of reproducibly controlling the permeation characteristics of the film was found. This difficulty can be avoided by chemically destroying the oxide film in the hydriding furnace with CCl_4 vapor and then metering H_2 into the furnace at a controlled rate. (auth)

34871 (UCRL-70340(Pt.1)) CVD TUNGSTEN AND TUNGSTEN-RHENIUM ALLOYS FOR STRUCTURAL APPLICATIONS. PART I. PROCESS DEVELOPMENT. Holman, William R.; Huegel, Frank J. (California Univ., Livermore. Lawrence Radiation Lab.). June 16, 1967. Contract W-7405-eng-48. 39p. (CONF-670905-5). Dep. CFSTI.

From Conference on Chemical Vapor Deposition of Refractory Metals, Gatlinburg, Tenn.

Results of a continuing program to develop CVD W and W Re

alloy structures with mechanical properties comparable to those of wrought products are presented. Equipment, techniques, and the effects of deposition variables are discussed. Effects of heat treatment and correlations with mechanical properties are given in a companion paper. Short lengths of ½-in.-dia tubing were prepared by H_2 reduction of the metal fluoride(s) on the outer surface of rotating, heated mandrels. New developments include: accurate control of the flow rate and WF_6/ReF_6 ratio by positive displacement metering of premixed liquid fluorides into a flash evaporator, and modification of the microstructure by mechanically rubbing the surface during the deposition process. Effects of temperature, pressure, gas composition (H_2/MF_6 and WF_6/ReF_6), gas velocity, mandrel rpm, and rubbing conditions are correlated with composition, macrostructure, microstructure, and deposition rate. Interpretations of microprobe data, replicas of the surface, and growth-ring effects are also included. Results are discussed in terms of deposition mechanisms and their probable effects on mechanical properties. (auth)

34872 SOME POSSIBILITIES OF ZONE MELTING FOR PURIFICATION OF MOLYBDENUM AND VANADIUM. Kovtun, G. P.; Kruglykh, A. A.; Finkel, V. A. Ukr. Fiz. Zh., 12: 1005-7(June 1967). (In Russian).

Purification of Mo and V by electron-beam zone melting was a result of the evaporation of volatile impurities. Purity was estimated by measuring the ratio of electric resistance at a room temperature to that at 4.2°K. The ratio values of the purest specimens were 15,000 and 20 for Mo and V, respectively. After zone melting the specimens of Mo and V had a single crystal structure. (auth)

34873 STUDIES OF NIOBIUM PENTACHLORIDE REDUCTION BY HYDROGEN. Elyutin, V. P.; Lysov, B. S.; Pepekin, G. I. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 3, 67-71(1967). (In Russian).

The rate of reduction of $NbCl_5$ to metal by H_2 was studied at 1200 to 2150°K. It was found that with the rise of the temperature of the filament, the rate of Nb precipitation increased, reaching a maximum at 1470°C after which it began to drop due to the sharp reduction of $NbCl_5$ on the heated surface. The results are in agreement with published literature, which suggested the temperature of 1400 to to 1600°C with partial $NbCl_5$ pressure in the mixture equal to 0.2 to 0.3 atm. (R.V.J.)

34874 FABRICATION OF NUCLEAR FUEL ELEMENT TUBES OF ZIRCONIUM ALLOYS. Reschke, S. (Schweizerische Metallwerke Selve and Co., Thun, Switzerland); Wiedemann, K. H. Metall, 21: 696-700(July 1967). (In German).

The production of Zr, the fabrication of fuel element tubes from Zircaloy-2 and the economic importance of Zr alloys with regard to the increasing demands in reactor construction are reviewed. (tr-auth)

34875 MELTING AND CASTING REFRACTORY OR REACTIVE METALS BY USING A PLASMA-ELECTRON-BEAM. Kashu, Seiichiro; Hayashi, Chikara (Japan Vacuum Engineering Co. Ltd., Yokohama). Nippon Kinzoku Gakkaishi, 31: 413-19 (1967). (In Japanese).

A plasma electron beam generated from a Ta hollow cathode source was used for melting Ti, Zr, Mo, and Ta button ingots. The beam was operated under Ar atmosphere between 1×10^{-3} and 5×10^{-1} torr. Results indicated that the furnace chamber should be evacuated to a high vacuum in the low 10^{-4} torr range before starting plasma generation. The purity of argon used for the process definitely affected the quality of the buttons. Buttons obtained under argon purified by using molecular sieve and liquid N_2 showed the same quality as ingots melted by using a high voltage electron beam. Ti-Al-Mn was successfully melted with a smaller loss of the volatile component than in the case of ordinary electron beam melting. The evaporation rate of Ti was controlled by changing the pressure in the melting chamber. The plasma electron beam was more stable and easier in operation than the high vacuum high voltage electron beam. (auth)

34876 THE BEHAVIORS OF FLUX $CaCl_2$ IN THE Ca-REDUCTION PROCESS OF ThO_2. Takeuchi, Sakae; Honma, Toshio; Satow, Tsuneo; Koyama, Keiji (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 31: 486-91(1967). (In Japanese).

Additions of $CaCl_2$ flux affect the yield of Th metal by Ca-reduction of ThO_2. In order to clarify the role of $CaCl_2$ in the Ca-reduction process, the difference in reducing rates of ThO_2 by molten Ca and by saturated Ca in $CaCl_2$, solubilities of Th and ThO_2 in $CaCl_2$ and molten Ca at 950 to 1050°C, were examined. Furthermore, the distribution of each component (Th, ThO_2, Ca, $CaCl_2$, CaO) in cake reduction was observed and the effects of briquetting and of stir of charge on the yield of Th were examined. Results indicated that the solubility of Th in $CaCl_2$ at 950°C was very small (about 35 ppM), and that of ThO_2 was nearly nil. The reduction of ThO_2 by saturated Ca in $CaCl_2$ was more dominant than that by molten Ca, possibly due to the difference in removing rates of the CaO layer by two reducers. The reducing power of Ca dissolved in $CaCl_2$ decreased rapidly with decreasing Ca content. The solubility of Th in molten Ca at 950°C is about 400 ppM. The reduction cake was very porous and the distributions of Th, ThO_2, $CaCl_2$ did not show clear regularity, possibly due to high viscosity of charge at reduction temperature. The briquetting of charge was effective in improving the yield of Th, especially in the shortening of the reduction time at relatively low temperatures. The stir of charge at the reduction temperature was not effective for improvement of the yield. (auth)

34877 FRICTION WELDING. (to American Machine and Foundry Co.). British Patent 1,073,357. June 21, 1967. Priority date July 10, 1963, United States.

The inertia or flywheel method of friction welding is applied to joining Zr or Zr-base alloy workpieces to a Ni-base alloy. Specific mention is made of use of the process to weld Zircaloy 2 and Inconel X. (P.G.C.)

Properties Evaluations

Refer also to abstracts 34244, 34858, 34919, and 35779.

34878 (AAEC/E-176) CREEP OF ISOSTATICALLY-PRESSED BERYLLIUM OXIDE. Kelly, J. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). May 1967. 5p. Dep.

The creep in bending of polycrystalline isostatically pressed BeO was studied in the temperature range from 800 to 1150°C for stresses up to 10^4 lb $in.^{-2}$. The minimum creep rate was found to be linearly proportional to stress and the process was temperature-dependent with an activation energy of 100 kcal $mole^{-1}$. Thus results were consistent with the Nabarro-Herring creep mechanism, the rate constant being 10^{-8} to 10^{-9} lb^{-1} $in.^2$ h^{-1}. (auth)

34879 (BMI-1803) SPECIFIC HEATS AND HEATS OF TRANSFORMATION OF ZIRCALOY-2 AND LOW-NICKEL ZIRCALOY-2. Eldridge, Edward A.; Deem, Herbert W. (Battelle Memorial Inst., Columbus, Ohio). May 31, 1967. Contract W-7405-eng-92. 17p. Dep. CFSTI.

The specific heats of Zircaloy-2 and low-Ni Zircaloy-2 at 0°C were 0.068 and 0.069 cal/(g)(C), respectively, while at 1050°C the specific heat was 0.085 cal/(g)(C) for both alloys. The enthalpy-versus-temperature data for Zircaloy-2 showed a break at about 635°C with an enthalpy increase estimated to be 0.38 cal per g probably resulting from Zr-Sn solubility. Low-Ni Zircaloy-2 enthalpy data showed a corresponding increase of approximately 0.35 cal per g at some temperature between 570 and 600 C. The $\alpha-\beta$ transformation for both materials started at about 810°C and continued to about 975°C; the heat of transformation for each material was 10.6 cal per g. An inflection in the specific-heat curve between 825 and 875°C probably resulted from the decreasing effects of very small amounts of Cr, Fe, and Ni in producing a transformation below the temperature at which pure Zr transforms. (auth)

34880 (BNWL-SA-940) DETECTION OF FATIGUE USING ULTRASONIC SURFACE WAVES. Dixon, N. E. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1967]. Contract AT(45-1)-1830. 22p. (CONF-670426-1). Dep. CFSTI.

From 6th Symposium on Nondestructive Testing, San Antonio, Tex.

The feasibility of measuring fatigue-induced effects by ultrasonic critical angle test techniques has been demonstrated. The critical angle tests involve the use of surface waves generated when the transmitted ultrasonic beam is incident on a test specimen at or near the Rayleigh critical angle. Conventional water coupling techniques were employed. The fatigue-induced effects were detected in the beam reflected and refracted from the water-specimen interface by a receiver transducer. The detected signal changes were due to the behavior of surface waves in the area of fatigue-induced effects. Fatigue effects were noted early in the fatigue life of a specimen. Al, stainless steel, and Cu were investigated. The initial success of the test indicates that by proper parameter selection and equipment design, practical tests for fatigue detection may be obtained with ultrasonic critical angle test techniques. (P.C.H.)

34881 (EURAEC-1687) PLOTTING OF 1,2 MD 0,7 STEEL TRANSFORMATION CURVES FOR AUSTENITIZATION TEMPERATURES OF 900 AND 1100°C. Special Report No. 16 April 1, 1966-June 30, 1966. (Chantiers de l'Atlantique Penh.-et-Loire, Paris (France)). June 1, 1966. Contract 054-61-12-RDF. 9p. (EUR-2874). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

Progress in determining transition curves for austenization of a low-C alloy steel is reported. Tests were conducted under argon and specimens were austenized at 900°C and 1100°C for 30 min. Different types of cooling, from water quenching to cooling at a controlled rate of 80°C/hr were applied. Results of hardness tests and micrographic examinations, are shown as are the transformation diagrams. (P.G.C.)

34882 (EURAEC-1859) NON-DESTRUCTIVE EXAMINATION OF WELDS. Final Report No. 1. (Roentgen Technische Dienst N. V., Rotterdam (Netherlands)). Apr. 20, 1967. Contract 045/61/5-RDH. 77p. (EUR-3364). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The aspects of nondestructive examination of welds in steel thicknesses up to 300 mm were investigated. The two methods considered were radiography and ultrasonic testing. For radiographic tests the optimum exposure conditions were defined, taking into account different types of radiographic films and the use of a variety of screens. Once the optimum exposure conditions were established an extra set of radiographs was made with a density of ~3, to compare the qualities of the radiographs obtained with the different sources of radiation. In comparison of the radiographs both the appearance of image quality indicators and inhomogeneities (cracks, slag, pores, and drilled holes) were incorporated. The image qualities obtained were plotted in a number of graphs for all the different radiation sources and thicknesses examined. There is no great difference between the quality of the different films. The dominant factor in the decrease of discernibility of inhomogeneities was the increase of thickness when the optimum exposure conditions could be met. Besides lead and tantalum, copper had good characteristics as a screen. Since Ta showed a tendency to buckle, its slightly better characteristics with respect to the obtainable image quality did not justify its use. Buckled Ta screens gave rise to unsharpness in the film and required a special heat treatment to be stretched. The rather drastic loss in flaw visibility observed with increasing thickness from 30 to 100 mm was not observed for a thickness increase from 100 to 300 mm. The decrease in flaw visibility appeared to be rather small and image quality expressed in wire sensitivity runs from an average of 0.65 to 0.37% for a thickness increase from 100 to 300 mm. For ultrasonic examination, different scanning techniques were tried. With the thickness involved and the type of weld defects one probe was insufficient. A probe angle of 45° seemed most appropriate. (M.C.G.)

34883 (EURAEC-1861) [PROPERTIES OF STEELS]. Quarterly Report No. 2.63, January 1–March 31, 1967. Leymonie, C. (Chantiers de l'Atlantique Saint-Nazaire (France)). May 31, 1967. Contract 054-61-12-RDF. 6p. (EUR-3365). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Final results of research on austenization and mechanical properties of three steels are briefly summarized. (P.G.C.)

34884 (FFA-108) CREEP DEFORMATION AND BUCKLING OF A CIRCULAR CYLINDRICAL SHELL UNDER AXIAL COMPRESSION. Samuelson, Ake (Flygtekniska Forsoksanstalten, Stockholm (Sweden)). Nov. 1966. 27p. Dep. SWED.

General equations were solved for elastic deformation and secondary creep of a circular cylindrical shell under axisymmetrical loads using an arbitrary, odd number of membranes. It was found that the double-membrane analogy yields an over-estimate of the deflection and stress rates, but the effect on the creep-buckling time as calculated from the approximate method was small in comparison with the scatter normally obtained at creep-buckling tests. Therefore, the double-membrane shell provides sufficiently accurate results for practical use. However, if a higher degree of accuracy is wanted, the 3-flange model yields a very close approximation to the solution provided by a multi-membrane shell. A few creep-buckling experiments were carried out on thin aluminium-alloy cylinders under various stress levels. The number of circumferential lobes developed on collapse decreased with a decreasing load level, and at a very low axial mean stress an axisymmetrical-buckling configuration was noted. The approximate buckling condition proposed in FFA-100 was applied to the test cylinders and fairly good agreement was found. (auth)

34885 (LA-1883) ELECTRICAL RESISTIVITY OF PLUTONIUM METAL AND OF GALLIUM–PLUTONIUM ALLOYS OVER THE TEMPERATURE RANGE OF 26°K TO ~773°K. Gibney, R. B.; Sandenaw, T. A. (Los Alamos Scientific Lab., N. Mex.). Nov. 4, 1954. Contract W-7405-eng-36. 26p. Dep. CFSTI.

Electrical resistivity measurements have been made on high-purity Pu metal and 3.5 atomic percent and 5 atomic percent Ga–Pu alloys over the temperature range of 26 to approximately 773°K. The resistivity of Pu metal reaches a maximum at 100°K. From 100°K to 650°K the material has a negative temperature coefficient of resistance (α, β and γ phases). The slope becomes positive in the δ and δ' phases. The ϵ phase had a zero temperature coefficient within experimental error. From 400 to 773°K the resistance-temperature curve of the Pu metal is quite flat. The electrical resistance of the 3.5 atomic percent Ga alloy peaked at 160°K. The resistivity values of the Ga–Pu alloys vary only a few percent in a temperature range of 500°K. (auth)

34886 (N-66-27077) DEVELOPMENT OF LIGHTWEIGHT MAGNESIUM ALLOYS FOR LOW TEMPERATURE APPLICATIONS. Annual Progress Report, June 19, 1964–June 18, 1965. Leavenworth, H. W. Jr.; Develin, H. F.; Mullen, L. R.; Di Giovanni, G.; Dunkerley, F. J. (American Machine and Foundry Co., Alexandria, Va. Materials Dept.). July 15, 1965. Contract NAS8-11168. 53p. (NASA-CR-64249). CFSTI.

Forty Mg alloys were melted and cast in a permanent mold. Of these, nineteen were successfully hot worked and tested at ambient and cryogenic temperatures. The nineteen successful alloys included fourteen modified alloys whose compositions were altered during the course of the program to achieve improved wrought properties. As expected, wide ranges of strength and ductility values were obtained which depended upon the composition of the alloys, the hot working temperature, and the heat treatment. The tensile strength of alloy II-4 (72Mg–1Zr–3Th–7Li–6Zn–5Cd–6Ag) varied from 51,000 psi to approximately 40,000 psi and the % elongation varied from 11% to 40% at ambient temperature depending upon the wrought structure. The maximum ductility of this alloy at cryogenic temperatures was a respectable 7.8%, but well below the established goals of the program. An elongation of 14% at cryogenic temperatures was obtained for alloy IA8 (76.5 Mg–1Zr–3Th–9Li–4Zn–2Al–4Ag–0.5Mn) with a corresponding tensile strength of 41,300 psi and a yield strength of 39,000 psi. The strength and ductility of this alloy are discussed in detail and recommendations for increasing its mechanical properties by variations in melting and casting techniques are presented. (auth)

34887 (N-66-32677) A STUDY OF THE ADHESION AND COHESION OF METALS. Interim Summary Report, March 9, 1965–March 9, 1966. Hordon, M. J.; Roehrig, J. R. (National Research Corp., Cambridge, Mass. Norton Exploratory Research Div.). [1966]. Contract NASw-1168. 43p. (NASA-CR-76828). CFSTI.

Measurements of the adhesion characteristics of a variety of metals were conducted in high vacuum. The contact surfaces were cleaned prior to loading by Ar or Xe ion bombardment or by wire brush abrasion. The applied loads exceeded the nominal yield stress. Although the ion bombardment produced substantial changes in the surface electron work function as determined by the retarded field diode technique, the resultant adhesion values were generally negligible. Smooth, flat surfaces of Cu showed greater bonding than roughened surfaces. Using the abrasion method, the adhesion of both soluble and insoluble metal pairs was studied. The results showed that lattice solid solubility was less important than surface cleanliness and ductility in governing the extent of interfacial welding. Under optimum conditions, bond efficiencies up to 90% were obtained for extremely ductile metals. (auth) (STAR)

34888 (N-67-19891) METALLURGICAL AND GEOMETRICAL FACTORS AFFECTING ELEVATED-TEMPERATURE TENSILE PROPERTIES OF DISCONTINUOUS-FIBER COMPOSITES. Petrasek, Donald W.; Signorelli, Robert A.; Weeton, John W. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar. 1967. 29p. (NASA-TN-D-3886). CFSTI.

The length–diameter ratio and the orientation of the fibers in discontinuous-fiber-reinforced composites were correlated to their elevated-temperature tensile properties. The composites were made of Cu and a Cu–2%-Cu alloy reinforced with W fibers having various length–diameter ratios. These composites were tested in tension at 300°, 900°, and 1500°F, and the results compared with continuous-length-fiber-reinforced composites containing the same matrix materials and fibers contents. The fiber orientation in the composite was extremely critical at elevated temperatures. Shear failures occurred at 1500°F for specimens in which the fibers were misalined from the tensile axis by as little as 3°. They also had significantly lower tensile strengths than composites having fibers alined parallel to the tensile axis. Tensile strengths of discontinuous-fiber-reinforced composites in which the fibers were alined parallel to the tensile axis were dependent upon the length–diameter ratio of the fibers in the composite. As the length–diameter ratio of the reinforcing fibers decreased, the tensile strengths of the composites decreased. Alloying the Cu matrix with Cr increased the matrix shear strength. The greater the shear strength, the higher the load transfer capabilities of the matrix. Thus, the tensile strength of composites with a Cu–2%-Cr matrix was higher than that of unalloyed-Cu-matrix composites having the same fiber content and the same length–diameter-ratio fibers. (auth) (STAR)

34889 (NASA-CR-54359) DEVELOPMENT AND EVALUATION OF MAGNETIC AND ELECTRICAL MATERIALS CAPABLE OF OPERATING IN THE 800° TO 1600°F TEMPERATURE RANGE. Sixth Quarterly Report, March 1, 1966–May 31, 1966. Report No. 66.39E. Kueser, P. E.; (and others) (Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.). June 1966. Contract NAS3-6465. 175p.

Developments in studies on magnetic and electrical materials capable of operating in the temperature range from 800 to 1600°F are reported. Advanced space electric power systems are the area of eventual application. Program I is directed at developing high-temperature magnetic materials with satisfactory strength for use in the solid rotors of electrical generators. The precipitation strengthened magnetic materials for final evaluation from 15-pound ingots have been selected. They were selected based upon their hardening response and stability. The stability was determined from isothermal aging studies on hardness and coercive force. The final martensitic alloy selected was Fe–12Ni–30Co–3Ta–1W–0.4Al–0.4Ti; and the final Co-base alloy was Co–15Ni–5Fe–1.3Al–5Ta–0.2Zr. Dispersion-strengthening has continued on Co–Fe and Co-base alloys. Low-coercive (<25 oersteds) force has been achieved, a problem area originally expected because of the nature of dispersion-strengthening. Saturation magnetization has been lowered in proportion to the volume of non-magnetic dispersoids. This is as expected. High-strength and creep resistance has been promoted by small interparticle spacings. Coarser particles tend to lower coercive force. Creep testing has continued on Nivco alloy which is the best, presently-available, magnetic rotor alloy. Six thousand two-hundred hours at 1100°F and a pressure of 1.7×10^{-9} torr has been achieved. Creep strain amounts to 0.66 percent. Program II will determine the feasibility of high-temperature capacitors using high-quality dielectric materials. A five-layer capacitor of BN with Pt electrodes completed its 250 hour stability test with no significant change in performance. Total capacitance change was only 1.39 percent which occurred in the first 65 hours. Program III incorporates developments on alkali-metal compatible ceramic-to-metal seals and combinations of material designed into a stator with a bore seal, a transformer, and a solenoid for investigations of compatibility under electrical and magnetic stress at elevated temperature and under high vacuum. Two four-inch bore seals were successfully fabricated joining high-purity beryllia (>99.8%) to Nb–1Zr using a wetting layer of Mo and a Zr–V–Nb active-metal braze. The stator, transformer, and solenoid continued on test at 1100°F hot-spot temperature in vacuum. Pressures have continued to decrease and are in the 10^{-9} torr range. No changes in performance have been observed in the electrical conductor performance after >4000 hours of testing. Electrical insulation performance on ac components also has been unaffected, but a slight decrease in resistance has been observed in the energized solenoid indicating that an invariant electrical stress on these materials may influence its performance. (auth)

34890 (ORNL-P-3159) MECHANICAL BEHAVIOR OF CVD TUNGSTEN AT ELEVATED TEMPERATURES. McCoy, H. E.; Stiegler, J. O. (Oak Ridge National Lab., Tenn.). [1966]. Contract W-7405-eng-26. 50p. (CONF-670905-7). Dep. CFSTI.

From Conference on Chemical Vapor Deposition of Refractory Metals, Gatlinburg, Tenn.

Many applications of CVD W require that the material be stressed at elevated temperatures. Creep-rupture tests at 1650 and 2200°C were made to evaluate the mechanical behavior of this material, and the properties compared with those of a typical heat of powder-metallurgy W. At 1650°C the CVD product has low fracture strains (approximately 5%) and a lower minimum creep rate. At high stresses the rupture life is shorter than that of the PM material; at low stresses the rupture lives are about equivalent. At 2200°C the minimum creep rate is higher and the rupture life lower for the CVD product. Microstructural features of importance noted in the CVD W include the formation and growth of voids, and the columnar nature of the grains. Fractographic techniques were used to study void nucleation and growth in the material. Nucleation appears to be spontaneous as the material is heated to elevated temperatures, indicating the presence of an impurity having a high vapor pressure. The growth appears to occur almost entirely by the stress-induced diffusion of vacancies into the void. At 2200°C under stress the voids reach such a large size that they comprise about 10% of the test specimen. The columnar grain structure of the material is important because it is very difficult to get extensive grain-boundary sliding and rotation in this type of structure. (auth)

34891 (ORNL-TM-1862) INDENTATION CREEP OF SOFT METALS. Larsen-Badse, Jorgen (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 37p. (CONF-670206-6). Dep. CFSTI.

From 96th Annual Meeting of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Los Angeles, Calif.

The phenomenon of indentation creep found at room temperature when flat punches are pressed under constant load into the surface of soft metals was studied. The depth of penetration D was in all cases proportional to the square root of time: $D = S\sqrt{t}$. The constant S depends upon the metal, the load, and the type of punch used and is related to the punch pressure according to $S \propto p^n$. The exponent n is the same as that found for the low-stress creep relation $\dot{\epsilon} \propto \sigma^n$; S may be considered to represent an average strain rate at a given depth of penetration and for a given punch size. The pressure required to obtain a certain S value decreases with an increase of the face area of the punch. This is due to the influence of punch size on the extent of the plastically strained zone and thus on the effective stress of deformation. (auth)

34892 (ORNL-TM-1869) YIELD STRESS AND PLASTIC STRAIN THEORY FOR ANISOTROPIC MATERIALS. Bogue, D. C. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 41p. Dep. CFSTI.

A yield stress and plastic strain theory is developed for anisotropic materials that show the Bauschinger effect. The theory is a generalization of Hill's anisotropic theory. The quadratic (Hill) terms are common to and predominate in both the yield stress criterion and the plastic strain equations; there are additional constants in both cases that are not interrelated. The formulation is motivated by the behavior of Zircaloy-2 and provides a good correlation of experimental data from a highly textured material. (auth)

34893 (SC-DC-66-2448) SPALLATION IN 6061-T6 ALUMINUM. Butcher, B. M. (Sandia Corp., Albuquerque, N. Mex.). May 1967. Contract AT(29-1)-789. 9p. (CONF-670914-2). Dep. CFSTI.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

Indirect evidence suggests that spall crack formation in 6061-T6 Al is influenced by impurities and foreign matter in the material. This conclusion is supported by the fact that easy crack growth is along planes of impurity stratifications in directions of grain elongation. Calculated stresses for crack formation due to impact are considerably greater than the true fracture strength of this material, determined from quasi-static tensile tests. (auth)

34894 (SLAC-PUB-320) MATERIALS IN ELECTROMAGNETS AND THEIR PROPERTIES. Brechna, H. (Stanford Linear Accelerator Center, Calif.). June 1967. Contract AT(04-3)-515. 47p. (CONF-670705-6). Dep. CFSTI.

From 2nd International Conference on Magnet Technology, Oxford, England.

Properties of low C and Si steels at room, elevated, and cryogenic temperatures such as magnetic and mechanical characteristics are discussed. The effect of impurities on coercive force, remanence field, and saturation values, as well as the influence of material inhomogeneities on field distribution in the useful aperture of magnets and on mechanical properties, are given. Nonferromagnetic materials used in magnetizing coils as Cu and its alloys, Al of various grades and purities; their physical properties such as resistivity, specific heat, and magneto-resistance as a function of temperature and strain, are discussed. Also dealt with are various types and techniques of insulation based on structural material and thermoset composites, their properties, such as hygroscopicity, mechanical strength, and fatigue. External influences, such as effect of water vapor and radiation are discussed. A short section is devoted to various aspects of manufacturing and insulation techniques, as well as current and proposed means of destructive and nondestructive testing procedures and programs. (auth)

34895 (SwRI-1228P7-37) TRANSITION TEMPERATURES OF SELECTED MATERIALS FROM LACBWR MAIN STEAM AND FORCED RECIRCULATION SYSTEMS. Special Report. Norris, E. B. (Southwest Research Inst., San Antonio, Tex.). June 28, 1967. Contract AT(11-1)-1228. 31p. Dep. CFSTI.

Materials meeting the nil ductility requirement for construction use in the LACBWR were tested. Drop weight nil ductility transition temperature tests and Charpy V-notch tests were made. Results are tabulated. (M.L.S.)

34896 (TID-23852) RESEARCH IN MATERIALS SCIENCE AND ENGINEERING. Annual Report, 1966–67. (Massachusetts Inst. of Tech., Cambridge). Mar. 1967. Contract AT(30-1)-1002. 450p. Dep. CFSTI.

Research progress is reported on: chemical and solid-state physics; electric, magnetic, and optical properties of materials and applications to devices; metallurgy and materials science; materials engineering; magnets; and instrumentation. (M.C.G.)

34897 (UCID-15169) THERMODYNAMIC PROPERTIES OF THE VAPOR DOME. Space Power Note No. 208. Oldham, John (California Univ., Livermore. Lawrence Radiation Lab.). June 30, 1967. Contract W-7405-eng-48. 37p. Dep. CFSTI.

Techniques that can be used to extrapolate the thermodynamic properties to the critical point within and on the vapor dome are considered. Emphasis is placed on the alkali metals sodium, potassium, and cesium. Data are presented in tables and graphs. (M.C.G.)

34898 (UCRL-70397) MEASURING TRANSIENT SURFACE TEMPERATURES WITH COATINGS OF TEMPERATURE-INDICATING MATERIALS. Parker, Robert (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 3, 1967. Contract W-7405-eng-48. 7p. (CONF-670903-1). Dep. CFSTI.

From 22nd Instrument-Automation Conference and Exhibit, Chicago, Ill.

In many pulse reactor experiments, the principal variable to be measured is the maximum surface temperature of some critical components. Hence, temperature-indicating materials may be advantageously used for this type of transient measurement. However, little is known of these materials when they are used to measure temperature under transient heating conditions. The energy stored in a low-inductance, high-voltage capacitor bank was discharged through a tapered stainless steel strip. The strip was heated in approximately 30 msec to some high temperature, which was measured with thermocouples and recorded with oscilloscopes. The strips were coated with various types of temperature indicators to evaluate the sensitivity and accuracy of the materials. In addition, high-speed color photography was employed to determine how quickly the indicators responded. In general, the speed and accuracy of Tempilaq, which undergoes a solid to liquid phase change, was superior to some other indicators. It was also concluded that thinner coatings responded faster (7 msec) to a sharp temperature rise. (auth)

34899 (WAPD-314) SLIDING-WEAR PERFORMANCE OF 135 MATERIAL COUPLES IN HIGH PURITY WATER AT 300°F AND 500°F. Dewees, N. B. (Bettis Atomic Power Lab., Pittsburgh, Pa.). May 1967. Contract AT(11-1)-Gen-14. 83p. Dep. CFSTI.

Wear performance data are presented for 135 metallic material couples (42 materials) tested in various combinations in sliding wear in a high purity water environment. Two sets of specimens for each material combination were tested simultaneously in a single rig with a contact pressure on the wear surfaces of 300 and 3000 psi at velocities of 1.39 and 0.135 inches per second, respectively. For most cases, sufficient test data are available to permit use of statistical quantities of mean value, a 95/95 tolerance limit, and a coefficient of variation to describe the wear rate. The composition of the materials tested, test procedure, and means of analyzing the data are given. The results are shown in chart form with a summary and an index. Results are evaluated according to the appearance of the worn surface, roughening tendency, wear rate, variability of wear rate with repeat testing, and consistency of wear rate under different conditions of testing. Wear performance on the rig used was compared with results from other wear test rigs. The wear evaluation for each material couple is valid for other applications having the same type of continuous motion and probably for reciprocating motion. (auth)

34900 (WCAP-3487-16) DEVELOPMENT OF HIGH STRENGTH VANADIUM ALLOYS. Final Report, December 1, 1964-December 31, 1966. Pollack, W.; Buckman, R. W.; Begley, R. T.; Thomas, K. C.; Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). June 1967. Contract AT(30-1)-3487. 162p. Dep. CFSTI.

A series of V-base alloys suitable for use as fuel cladding in liquid metal cooled fast breeder reactors was investigated. Forty-five 200-g. button melts and eight 2.5-inch diameter (3.5 lb.) ingots were melted. Strengthening was accomplished through a combination of solid solution and dispersed phase hardening. Solid solution strengthening was attained through additions of Cr, Fe, Nb, Mo, W, Ta, and Ti, while combinations of Zr or Ti and C or N were used to achieve dispersed phase strengthening. In addition, 2.5-inch diameter ingots of the reference V-10 Ti and V-20 Ti alloys were melted to provide a basis for comparing the experimental alloys formulated by Westinghouse. The melts were processed to 0.042-inch sheet and characterized by hardness, tensile, and creep tests. An evaluation of weldability was conducted and attempts were made to identify precipitate phases observed in the microstructure. In addition, the compatibility of several alloys with ceramic fuels was investigated at 800°C, and 500-hour sodium corrosion tests were also performed. On the basis of short-time tensile strength, Ti, Ta, and Nb proved the most effective solid solution strengtheners. Cr proved the least effective. Nb by itself and in combination with Fe resulted in lower creep rates, while significant improvements were achieved through additions of Zr and C. Several compositions could be significantly strengthened by heat treatment. The results of the Na corrosion tests showed the weight gains of the experimental alloys to be essentially equivalent to those of the V-10 Ti and V-20 Ti alloys. Good compatibility was exhibited between all of the alloys and the UC fuel pellets with the exception of three alloys containing Fe. These latter showed some reaction when in contact with Na-bonded, Fe-modified, carbide fuel. The following compositions exhibited excellent creep strengths in combination with satisfactory fabricability, corrosion resistance, and fuel compatibility, and therefore are recommended for more detailed evaluations: V-9.11Cr-3.27Fe-1.33Zr-0.053C, V-8.49Cr-9.85Ta-1.24Zr-0.05C, and V-6.36Fe-5.3Nb-1.3Zr-0.05C. (auth)

34901 EFFECT OF SUBSTRATE TEMPERATURE ON THE ELECTRIC CONDUCTIVITY OF FILMS PRODUCED BY EVAPORATING TANTALUM IN A VACUUM. Lainer, D. I.; Kholmyanskii, V. I. Fiz. Metal. Metalloved., 23: 440-3(Mar. 1967). (In Russian).

The electrical conductivity of Ta films obtained by evaporating Ta in a vacuum ($5 \cdot 10^{-6}$ mm Hg) was investigated as a function of film thickness at various substrate temperatures. Ta was evaporated from a drop placed in a water-cooled copper crucible and subjected to electron-beam heating. The substrates, measuring $20 \times 7 \times 0.5$ mm, were placed at a distance of 245 mm from the drop of metal and were heated by means of a flat spiral of tungsten wire. The deposition rate varied within the limits of from 0.02 to 0.04 Å/sec. The thickness at any time instant and the deposition rate were calculated as a function of overall thickness and deposition time. Conductivity (in $ohm^{-1}\text{-}cm^{-1}$) was determined as a function of current and of film thickness. Findings: for films of identical thickness conductivity increases with increase in substrate temperature. There exists a conditional critical thickness—conditional because it depends on the sensitivity of the recording instrument—below which the film displays no appreciable conductivity: 2 to 4 Å. At that moment the film represents a set of isolated granules and the mechanism of conduction in such films is more of a semiconductor than of a metal nature. Subsequently, as film thickness increases, the granules grow and merge and the conductivity rapidly increases and increasingly depends on the conductivity of the granules themselves. Even at substrate temperatures as high as 550°C, however, conductivity is only 4000 $ohm^{-1}\text{-}cm^{-1}$, which is only $\frac{1}{30}$ of conductivity of the bulk metal; this probably is due to the presence of a large number of defects in the structure of the thin film and perhaps also to the formation of lower oxides and carbides. (ATD)

34902 MEASUREMENT OF DIFFUSION OF GOLD IN COPPER BY ELASTIC SCATTERING OF DEUTERON. Kawasaki, Satoru; Sakai, Eiji (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 4: 273-7(June 1967).

A Si semiconductor radiation detector was used to study the diffusion of Au into Cu in the temperature range from 356 to 440°C by detecting elastically scattered deuterons. In this temperature range, the measured diffusion coefficients of Au into Cu were somewhat larger than the results of Sippel's experiments, while the activation energy of the diffusion was roughly the same. Diffusion lengths ($=\sqrt{Dt}$) as small as 2×10^{-7} cm can be measured by this method, which may make it possible to detect the effects of radiation damage on diffusion phenomena in metals. (auth)

34903 INVESTIGATION OF RHENIUM AND MOLYBDENUM DIFFUSION IN TUNGSTEN AND ITS ALLOYS. Larikov, L. N.; Tyshkevich, V. M.; Chernaya, L. F. Ukr. Fiz. Zh., 12: 986-90 (June 1967). (In Russian).

By means of the isotopes ^{99}Mo and ^{188}Re coefficients of Mo and Re volume diffusion in single crystal and polycrystalline W and alloys of W with Mo and Re over a temperature range of 1900 to 2400°C were determined. The effective coefficients of Mo and Re volume-diffusion in polycrystalline W differ from the intrinsic ones in single crystals. With lower annealing temperature, mobility of Mo and Re in W-Mo and W-Re respectively is essentially higher than in polycrystalline pure W. Concentration dependence of diffusion velocity in the system W-Mo is obtained. (auth)

34904 THERMAL CONDUCTIVITY OF SOME METALS AND ALLOYS AT 4.2 TO 273°K. Merisov, B. A.; Khotkevich, V. I.; Zlobintsev, G. M.; Kozinets, V. V. (Kharkov State Univ.). Inzh.-Fiz. Zh., 12: 675-7(May 1967). (In Russian).

A thermal potentiometer method of measuring thermal conductivity, which includes experimental determination of a correction for radiation in the Fourier formula for single-axis heat flow along a cylindrical specimen, has been proposed. The thermal conductivities of Nb, Mo, and AD-1, AMG-6, AMG-3, D-16, VT-1 and

1Kh18N10T alloys were measured by this method. This method has the advantage that no additional heater on the screen, no special treatment of the specimen surface, and no additional tests over the entire temperature range to calculate the radiation are required. (ATD)

34905 THERMAL CONDUCTIVITY OF PLUTONIUM METAL. Andrew, James F. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. J. Phys. Chem. Solids, 28: 577-80(Apr. 1967). (LA-DC-8166).

The thermal conductivity of α-Pu was determined at 80, 195, and 300°K. The measurements gave room-temperature values of about 0.065 W/cm°K, which decreased with decreasing temperature to about 0.030 at 80°K. (auth)

34906 EFFECT OF OXYGEN AND CARBON ON THE CREEP STRENGTH OF NIOBIUM. Rawson, J. D. W.; Argent, B. B. (Sheffield Univ., Eng.). J. Inst. Metals, 95: 212-17(July 1967).

The effect of 0.01 to 0.12 wt % O_2 and 0.03 to 0.06 wt % C on the creep strength of Nb at 800 to 1200°C was investigated over the stress range 1500 to 5000 lb/in.^{2}. Above 1050°C the addition of O_2 had little influence on the creep strength, but at lower temperatures creep rates were reduced. The activation energy for the creep of Nb was determined by temperature-change experiments to be ~97 kcal/mole. This value was not affected by O_2 content or stress over the temperature range 850 to 1250°C. (auth)

34907 ALLOYING ELEMENT INFLUENCE ON MECHANICAL PROPERTIES AND RECRYSTALLIZATION TEMPERATURE OF TANTALUM ALLOY WITH 33 PERCENT NIOBIUM. Levin, A. M.; Zhorova, L. P.; El'manovich, V. N. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 3, 122-6(1967). (In Russian).

Studies of the influence of Mo, V, Re, Zr, and Ti impurities on mechanical properties, stability, and recrystallization of Ta–Nb alloys showed that additions of Mo, Re, and V improve the stability of the alloy at room temperature, heat resistance at 1100°C, and continuous stability at 1500°C. Additions of Ti reduce the stability of the alloy. The Ta–Nb alloy with 30 to 35% Nb and 3 to 4% Re proved the best suitable material for construction of electric vacuum devices operating under cyclic conditions at 20 to 1500°C. (R.V.J.)

34908 SOME PROPERTIES OF COPPER–HIGH ZIRCONIUM–HIGH CHROMIUM ALLOYS. Suzuki, Hisashi; Kawakatsu, Ichiro; Kitano, Hitoshi (Tokyo Univ.). Nippon Kinzoku Gakkaishi, 31: 342-6(1967). (In Japanese).

Studies on the properties of Cu–Zr–Cr alloys containing 0.73 ~ 1.46% Zr and 0.77 ~ 1.93% Cr were carried out. Results were compared with those on studies of Zr and Cu-high Cr alloys. The temperatures of 950 and 450°C were found to be best suited for solution-treatment and aging of Cu–Zr–Cr alloys, respectively. Their mechanical properties, such as hardness and tensile strength, were extremely superior to Cu–Zr and Cu–Cr alloys. The reason may be due to the increased solid-solubility in Cu–Zr–Cr alloys. Electric conductivity of the alloys was somewhat lower than the others: however, it was found that conductivity increased remarkably by prolonged aging, affecting almost no reduction in strength. The sequence of precipitation in Cu–Zr–Cr alloys appeared to be a combination of Cu–Zr and Cu–Cr alloys. Heat resistivity and electric conductivity of the alloys could be explained in relation to those of Cu–Zr and Cu–Cr alloys. The characteristic properties of Cu–Zr–Cr alloys which are more than 60 kg/mm^2 in strength and more than 80% IACS in conductivity were easily obtained. (auth)

34909 CHARACTERISTICS OF Cu–W–Co AND Cu–WC–Co CONTACT ALLOYS FOR HEAVY CURRENT APPLICATIONS. Takeuchi, Hisasuke; Tomita, Sadami; Ohsawa, Makoto (Hitachi Research Lab., Japan). Nippon Kinzoku Gakkaishi, 31: 428-33 (1967). (In Japanese).

In order to develop new electrical contact materials, sintered Cu–W–Co and Cu–WC–Co alloys were prepared, and their life tests were carried out using a modified ASTM type testing apparatus at ac 105V, 50A. The results showed that the higher Co content gave a smaller weight loss, a lower contact resistance, and a larger welding tendency as expressed by the number of welds formed. Especially in Cu–WC–Co alloys, these characteristics were remarkable and the contact resistance maintained a very low value. Assuming that the above-stated features depended mainly on the properties of Cu–Co matrix, contact specimens of binary cast Cu–Co alloys were prepared and tested. The addition of Co gave an appreciable effect on the electrical contact characteristics of Cu, i.e., the lowering of contact resistance and an increase of welding number were observed. These results were in good agreement with those for the sintered ternary alloys. (auth)

34910 ELEKTRONNYE SVOISTVA METALLOV I SPLAVOV. (Electron Properties of Metals and Alloys). Svechnikov, V. N. (ed.). Kiev, Izdatel'stvo Naukova Dumka, 1966. 132p.

Ten articles are presented on electron properties of metals and alloys of various metals. The first article handles the theory of superconductivity in a phonon model, the rest of the articles are concerned with magnetic structure and properties of Pt-, Pd-, and Cr-base alloys, effects of deformation on Ni–Cu and Al–Cu systems, and atomic x-ray scattering and electron density of KCl. (R.V.J.)

34911 TANTALUM-BASE ALLOYS. (to Westinghouse Electric Corp.). British Patent 1,072,829. June 21, 1967. Priority date May 10, 1965, United States.

Tantalum-base alloys, containing 6 to 7% W, and minor additions of Hf, Mo, Re, or Zr, with dispersed secondary phases of complex carbides and/or nitrides were developed. The alloys were fabricable by forging or rolling after annealing at 1650°C, had high resistance to creep deformation at elevated temperatures, were weldable, and compared favorably in tensile properties with alloy T-222. (P.G.C.)

Structure and Phase Studies

Refer also to abstract 35217.

34912 (AAEC/E-170) FEASIBILITY OF DISPERSED PHASE GRAIN REFINEMENT IN CERAMICS. Woolfrey, J. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1967. 27p. Dep.

The feasibility of dispersed phase grain refinement in ceramics is assessed. Conditions for grain size stabilization of normal growth are derived using a Zener type analysis for random dispersions and for the case in which all particles are located at specific sites upon a grain boundary. The calculations predict the relative stabilizing effects of particles located at grain boundaries, triple-grain edges, and four-grain corners. Other factors reviewed include the effects of particle size instability, nucleation of discontinuous grain growth, and possible methods for its prevention. It is concluded that dispersed phase grain refinement in ceramics is feasible. The general predictions are applied to the case of a BeO moderator and used to predict the most promising additives for further investigation. (auth)

34913 (AFML-TR-66-366) RARE EARTH–MANGANESE ALLOYS, THEIR PREPARATION, CRYSTAL STRUCTURES, PHASE DIAGRAMS, AND MAGNETIC PROPERTIES. Technical Report, April 1, 1962–March 30, 1966. Kirchmayr, Hans R.; Lihl, Franz (Technische Hochschule, Vienna (Austria)). Nov. 1966. Contract AF61(052)-609. 46p.

The compounds and alloys between rare earth (RE) metals and manganese have been studied systematically. For the preparation of these alloys a special technique has been developed, the so-called amalgam process, which consists of heat treating an RE–Me–amalgam, where RE can be any RE metal and Me any other metal. The process yields mercury-free, well-annealed compounds without a melting process at temperatures between 800 to 1100°C. On thus prepared RE–Mn alloys the crystal structures of the intermetallic compounds with the formulas $REMn_2$, RE_6Mn_{23}, and $REMn_{12}$ have been determined to be of the $MgCu_2$ or $MgZn_2$, Th_6Mn_{23}, or $ThMn_{12}$ type, respectively. The phase diagrams of the RE–Mn system (RE = Gd, Dy, Ho, Er) have been established mainly by differential thermal analysis. All of these intermetallic compounds are formed peritectically. The magnetic properties of the intermetallic compounds present in the investigated systems have been determined in the temperature range 80 to 1400°K. The magnetization, saturation magnetization, and susceptibility as well as the Curie points and magnetic moments have been established. Various modes of ferrimagnetic coupling of the moments were observed. A mechanism is proposed which can explain the experimental results and is consistent with theoretical considerations. (auth)

34914 (NUMEC-3428-32) GROWTH OF SINGLE CRYSTALS OF PLUTONIUM. Progress Report, January 1–March 31, 1967. (Nuclear Materials and Equipment Corp., Apollo, Pa.). June 1967. Contract AT(30-1)-3428. 12p. Dep. CFSTI.

A parametric study to determine the effects of the primary recrystallized grain size and the amount of critical straining as related to the growth of large grains of Ga-stabilized delta-phase Pu was initiated, using the strain-anneal method for growing single crystals. After introducing a 0.3% critical strain into a 1.22 w/o Ga-stabilized delta-Pu tensile blank, having a primary recrystallized average grain size of 0.030 mm, grains were grown in the specimen to a diameter of 0.087 mm by annealing in a temperature-gradient furnace. (auth)

34915 (NYO-2731-8) PHASE EQUILIBRIA AND SPECIFIC VOLUMES OF LIQUID METALS AND ALLOYS. Report No. 6. [Progress Report]. Kanda, Frank A. (Syracuse Univ. Research Inst., N. Y. Dept. of Chemistry). May 1967. Contract AT(30-1)-2731. 31p. (CHEM-1620.871). Dep. CFSTI.

Developments in liquid metal studies are reported. These include density studies on Tl–Te and Tl–Mg, viscosity studies on Hg, Pb, and Sn, and crystal structure studies of $SrMg_2$ and Sr_2Mg_{17}. (P.C.H.)

34916 (UCRL-17521) LOW-TEMPERATURE DISLOCATION MECHANISMS. Dorn, John E. (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1967. Contract W-7405-eng-48. 55p. (CONF-670513-6). Dep. CFSTI.

From Colloquium on Dislocation Dynamics Conference, Seattle, Wash.

A classification of dislocation mechanisms is presented. The dislocations are grouped into 3 categories: localized, linear, and volumetric. Typical examples of each type are considered. Cutting localized obstacles, variations from the idealized prototype, randomly distributed localized obstacles, plastic deformation arising from cutting of localized obstacles, prototype model for linear obstacles, and screw dislocations are discussed. (M.C.G.)

34917 (AERE-Trans-1069) BASIC TYPES OF DEFORMATION MICRO-CONTOUR APPEARING AT ELEVATED TEMPERATURES IN POLYCRYSTALLINE METALS HAVING A FACE-CENTRED CUBIC LATTICE. Lozinskii, M. G.; Pertsovskii, N. Z. Translated by J. W. Newmarch Holmes for Atomic Energy Research Establishment, Harwell, Eng., from Izv. Akad. Nauk SSSR, Otd. Tekh. Nauk Met. Topl., No. 1, 105-26(1962). 30p. Dep. CFSTI. UK 4s.

All types of deformation micro-contour were divided into two groups: those that appear within the grains of metals and alloys subjected to deformation over a wide temperature range and those that appear principally on the grain boundaries during testing under these conditions. The first group of micro-contours includes a variety of intragranular displacement contours appearing in metals and alloys having an fcc lattice during deformation and in the appearance of areas having a reoriented lattice. The kinetics of development of complex micro-contour were studied. (59 references). (M.C.G.)

34918 STRUCTURE OF A TUNGSTEN FACE (110) COVERED WITH A FILM OF ADSORBED OXYGEN. Gorodetskii, D. A.; Mel'nik, Yu. P.; Yas'ko, A. A. Ukr. Fiz. Zh., 12: 970-6(June 1967). (In Russian).

A study of an O_2-covered W face (110) was carried out using low-energy electron-diffraction techniques. After heating to various temperatures, changes of the work function and diffraction patterns were observed. From the intensities of the newly formed diffraction spots it was assumed that the face was reconstructed with the surface layer now containing W atoms as well as O. (auth)

34919 SOLID-STATE TRANSFORMATIONS OF TITANIUM–ZIRCONIUM ALLOYS. Kuprina, V. V.; Bernard, V. V.; Grigor'ev, A. T.; Sokolovskaya, E. M. Vestn. Moskov. Univ., Ser. II, Khim., No. 5, 69-73(Sept.-Oct. 1966). (In Russian).

Microscopic and x-ray analysis, changes in hardness and microhardness, and high-temperature thermal analysis were used to follow the transformations in Ti–Zr alloys. The properties of the alloys were determined after quenching from 1150, 1000, 800, 600, and 400°C, and after annealing for 50 hr at 1150°C and 940 hr at 400°C. The phase diagram of the Zr–Ti system from 20 to 1200°C is similar in its main features to that reported in the literature. The β-solid solution can exist without breaking down only at high temperatures. The transition to an α-solid solution is accompanied by the formation of a narrow two-phase region ($\alpha + \beta$) with a minimum transition at 520°C and 50 at. % Zr. Alloys homogenized and quenched from 1000 and 1150°C showed a martensitic structure. The change in microhardness confirmed the two-phase structure of the alloys. Quenching from 400°C showed that the alloys were single-phased at this temperature, as confirmed by x-ray analysis. Hardness values on samples quenched from 1150, 1000, and 800°C showed two maxima in the concentration range of 20 to 30 and 65 to 80 at. % titanium due to a martensitic transformation. (TTT)

34920 SOLID-STATE TRANSFORMATIONS OF NIOBIUM ALLOYS WITH ZIRCONIUM AND TITANIUM. Grigor'ev, A. T.; Sokolovskaya, E. M.; Kuprina, V. V.; Raevskaya, M. V.; Guzei, L. S.; Sokolova, I. G. Vestn. Moskov. Univ., Ser. II, Khim., No. 5, 57-63(Sept.-Oct. 1966). (In Russian).

The ternary Nb–Zr–Ti system was studied over the entire region of concentrations for 5 at. % of each component. The microstructures of cast, homogenized, annealed, and quenched samples were investigated at 400, 600, 800, 1000, and 1150°C. The change in hardness as a function of composition was determined after various thermal treatments, as was the microhardness. High-temperature thermal analyses were carried out on the samples, and the change in electrical resistance with temperature and x-ray studies were performed. The samples containing 5 to 25 at. % Ti showed a typical behavior of the alloys. At high temperatures (above 1000°C) the components formed a continuous solid solution. Then the ternary solid solution broke down into two phases ($\alpha_{Zr} + \beta_{Zr}$) below 1000°C due to the polymorphism of Zr. Two solid solutions ($\beta_{Nb} + \beta_{Zr}$) can also form from the ternary solid solution. On lowering the temperature further, the two-phase regions $\alpha_{Zr} + \beta_{Zr}$ and $\beta_{Zr} + \beta_{Nb}$ intersect to give the beginning of a monotectoid transformation, as shown by the microstructure of quenched and annealed samples, and also by thermal and x-ray data. Thus, quenching from 1150°C showed that alloys rich in Zr have a martensitic structure, which gives a homogeneous solid solution structure on increasing the Nb content. Ti significantly increases the mutual solubility of the components in each other, and decreases the temperature at which the β-solid solution breaks down. (TTT)

34921 SOLID-STATE TRANSFORMATIONS OF NIOBIUM ALLOYS WITH ZIRCONIUM AND TITANIUM. Grigor'ev, A. T.; Sokolovskaya, E. M.; Kuprina, V. V.; Treusknikova, O. F. Vestn. Moskov. Univ., Ser. II, Khim., No. 5, 64-8(Sept.-Oct. 1966). (In Russian).

In a continuation of a previous study of Nb–Zr–Ti alloys, the Ti content of the alloy was increased in steps of 5 at. % from 30 to 95% Ti, and the microstructures of quenched and annealed samples were investigated over a temperature range of 20 to 1150°C. A mechanical mixture of $\alpha + \beta$ phases formed from the ternary β-solid solution due to the polymorphism of Ti and Zr. The beginning of the polymorphic transformation took place at about 600°C. The two-phase structure of the alloys below 600°C was confirmed by x-ray analysis. One of the phase was body-centered, and the other was hexagonal. The change in hardness is given. (TTT)

34922 SOLID-STATE TRANSFORMATIONS OF Cr–Mo ALLOYS RICH IN Cr. Bezus, E. V.; Sokolovskaya, E. M.; Grigor'ev, A. T.; Pavlov, V. P.; Pereladova, L. A.; Sokolova, I. G. Vestn. Moskov. Univ., Ser. II, Khim., No. 5, 74-8(Sept.-Oct. 1966). (In Russian).

The methods of differential thermal analysis, hardness and microhardness, electrical resistance at high temperature, x-ray and microscopic analysis after annealing for 1150 hours and quenching from 1550, 1300, 900, and 600°C were used to follow the solid-state transformations of Cr–Mo alloys analogous to transformations in pure Cr at 1000, 1350, 1650, and 1830°C. Four two-phase regions were found: $\alpha + \beta$; $\beta + \gamma$; $\gamma + \delta$; and $\delta + \epsilon$. These two-phase regions occurred at the above temperatures, which continuously decreased with increasing Mo content. The single-phase and two-phase structure of the alloys quenched from a certain temperature were found to alternate in a regular fashion with increasing Mo content. Thus, on quenching from 1550°C, pure Cr and alloys with 0.2 and 1% Mo have the structure of a solid solution (γ-region). Separation of a second phase ($\gamma + \delta$-region) was observed in alloys with 2 at. % Mo. Alloys with 3 to 5 at. % Mo have a single-phase structure (δ-solid solution), and alloys with 6 to 10 at. % Mo show a second phase ($\delta + \epsilon$-region). Alloys with a high Mo content have the structure of a solid solution (ϵ-region). Lattice parameters and hardness values are given for the various phases. (TTT)

34923 PHASE DIAGRAM OF NIOBIUM–TITANIUM SYSTEM. Guzei, L. S.; Sokolovskaya, E. M.; Grigor'ev, A. T. Vestn. Moskov. Univ., Ser. II, Khim., No. 5, 79-82(Sept.-Oct. 1966). (In Russian).

Microscopic and x-ray analysis, and determination of the hardness of cast, homogenized, annealed, and quenched samples were used to obtain the phase diagram of the Nb–Ti system from 20 to 1200°C. Homogenization was carried out at 1600 to 1900°C for a period of 10 to 15 hours. The samples were quenched from 1150, 1000, 800, 600, and 400°C. Homogenized alloys and alloys quenched from 1150 and 1000°C had the structure of a solid solution with the exception of alloys containing <12% Nb, which had a martensitic structure. At 800°C alloys with 4 at. % Nb had a two-phase structure. Alloys with 4 to 12 at. % Nb had a martensitic structure. Significant widening of the $\alpha + \beta$ region was observed on lowering the quenching temperature to 600 and 400°C. X-ray analyses on samples quenched from 1150 and 800°C indicated that the alloys have body-centered-cubic lattice at these temperatures. (TTT)

34924 INTERACTION BETWEEN $TiCr_2$ COMPOUND AND MOLYBDENUM. Samsonova, N. N.; Budberg, P. B.; Kornilov, I. I.; Asanov, U. A. (Inst. of Metallurgy, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 1878-81(Oct. 1966). (In Russian).

A series of Cr–Ti–Mo alloys with compositions located on the $TiCr_2$–Mo section of the ternary Cr–Ti–Mo system was scull

melted from 99.99%-pure components and studied by various methods of physicochemical analysis. Mo was found to stabilize the β-phase ternary-Mo–Cr–Ti solution, to raise the solidus temperature and to lower the temperature of the $\beta \rightarrow \delta + \beta \rightarrow \delta$ transformation. The microhardness of the alloys at 1300, 1200, and 600°C increases with increasing Mo content, reaches a maximum of about 820 kg/mm^2 at 6.5% (1300°C) or about 825 and 870 kg/mm^2 at 8% (1200 and 600°C) Mo and then drops rather sharply with further increase in Mo content. (ATD)

34925 PHASE DIAGRAM OF THE Nd–Te SYSTEM AND PHASE PROPERTIES. Zinchenko, K. A.; Luzhnaya, N. P.; Yarembash, E. I.; Eliseev, A. A. (Inst. of General and Inorganic Chemistry, Moscow). Izv. Akad. Nauk SSSR, Neorg. Mater., 2: 1747-56(Oct. 1966). (In Russian).

Differential-thermal and microstructure analysis was made of Nd–Te systems and phase diagrams were constructed for Te concentrations from 0 to 100 at. %. Seven individual phases (NdTe, Nd_3Te_4, Nd_2Te_3, Nd_4Te_7, $NdTe_2$, Nd_3Te_5, and NdTe, were observed the first time. The syngony, spatial groups, and periods were determined for Nd_2Te_7 and $NdTe_3$ compounds. (R.V.J.)

34926 HANDBOOK OF LATTICE SPACINGS AND STRUCTURES OF METALS. VOLUME 2. Pearson, W. B. International Series of Monographs in Metal Physics and Physical Metallurgy. Volume 8. Oxford, Pergamon Press, 1967. 1446p. £25.

A classification of the structures of metals and alloys is presented, together with tabulations of lattice parameters and data on elemental metals, metalloids, intermediate phases in alloy systems, borides, carbides, hydrides, nitrides, and binary oxides. An alphabetical index of work on the foregoing materials is also included. (UK)

Radiation Effects

Refer also to abstracts 34244, 35217, and 35717.

34927 (AECL-2677) EFFECT OF NEUTRON IRRADIATION ON THE HIGH TEMPERATURE TENSILE PROPERTIES OF SOME NICKEL-CONTAINING ALLOYS. Lawson, V. B. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Mar. 1967. 84p. Dep. CFSTI. CAN $2.00.

Post irradiation tensile properties of Alloy 600, Alloy X-750, commercial Ni, a 70% Ni–30% Cu alloy, 304 ELC stainless steel, and two heats of a 32% Ni–21% Cr–Fe alloy were determined at temperatures from 300 to 1000°C. The neutron dosage ranged from 0.25×10^{19} n/cm^2 (E > 1 MeV) 1.1×10^{19} n/cm^2 (thermal) to 5.8×10^{19} n/cm^2 (E > 1 MeV) 19.7×10^{18} n/cm^2 (thermal). All alloys lost ductility above approximately 550°C. This loss was not greatly affected by pre- or post-irradiation heat treatments or by the starting condition of the alloys. A strain-rate dependence of the loss was determined, but no grain size effect was evident. The strength of Alloy X-750 was affected by irradiation. Precipitation mechanisms in the irradiated solution-treated material appeared to be affected. Metallography revealed some grain boundary changes. Stress-rupture tests of two irradiated Ni–Cr–Fe alloys revealed losses of stress rupture strength and ductilities. (auth)

34928 (AECL-2661) THE BEHAVIOUR OF ZIRCALOY-2 AND Zr–2.5 PERCENT Nb CLAD URANIUM DIOXIDE FUEL IN AN ORGANIC COOLANT. THE X-719 IRRADIATION. Walker, J. F. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Nov. 1966. 26p. (EXP-NRX-71907). Dep. CFSTI. CAN $1.00.

Three Zircaloy-2-clad and three Zr–2.5% Nb-clad elements were successfully irradiated in the X-7 loop, at WR-1 temperatures and ratings. Some of the elements were at power for 117 days and reached a burnup of 3500 MWd/Te U. H_2 absorption by the cladding alloys was studied in detail by analysis and metallography. The absorption rate for Zr–2.5% Nb was 0.04 μg cm^{-2} h^{-1}, which was about half that of Zircaloy-2. H_2 picked up by the cladding had diffused to the cooler wire wrap, which was severely embrittled on the Zircaloy-2 elements. Surface fouling was negligible. Surface oxidation and fission gas release from the fuel were both small. The results indicate that the WR-1 Zr–Nb-clad production elements will perform satisfactorily to their designed burnup. (auth) (Canada)

34929 (BNWL-SA-373) THE CREEP OF ANNEALED 304 STAINLESS STEEL DURING IRRADIATION AND ITS ENGINEERING SIGNIFICANCE. Williams, J. A.; Carter, J. W. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 17, 1966. Contract AT(45-1)-1830. 20p. (CONF-660607-11). Dep. CFSTI.

From 3rd International Symposium on the Effects of Irradiation on Structural Metals, Atlantic City.

Annealed 304 stainless steel creep properties during neutron irradiation were determined in the temperature range from 500 to 750°C and in the stress range from 10,000 to 30,000 psi. The minimum creep rates determined for creep during irradiation are essentially the same as those for unirradiated annealed 304 stainless steel. Creep rates are correlatable with the Arrhenius equation and the Larson–Miller parameter. Although little difference in creep rates was observed, significant reduction in creep-rupture properties occurred during irradiation. Both reductions in creep-rupture time and creep-rupture strain were observed. The data lends itself to parametric correlations of rupture time. In-reactor and ex-reactor creep-rupture strains were found to have different temperature dependence. (auth)

34930 (KAPL-3161) EFFECT OF NEUTRON IRRADIATION IN 550F LOOP WATER ON THE MECHANICAL PROPERTIES OF Ni–Cr–Fe ALLOY 600, Ni–Cr–Fe WELD METAL, AND TYPE 347 STAINLESS STEEL. Final Report. Powers, A. E.; Baldwin, E. E. (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 27, 1967. Contract W-31-109-eng-52. 31p. Dep. CFSTI.

Results of a program, initiated in 1959, to determine the effect of neutron irradiation on the mechanical properties of Ni–Cr–Fe Alloy 600, Ni–Cr–Fe Alloy 600 weld metal, and Type 347 stainless steel are presented. Irradiation was carried out in the Engineering Test Reactor (ETR) to a maximum dose of about 5×10^{21} nvt (>1 MeV). The increase in yield strength was proportional to the square root of the dose up to about 1×10^{21} nvt (>1 MeV). At 1×10^{21} nvt, a plateau was reached at yield strengths of 100,000 to 130,000 psi for both the Ni–Cr–Fe Alloy 600 and the Type 347 stainless steel. Elongation was a function of the yield strength, and the uniform elongation diminished to very small amounts when the yield strength was raised by irradiation to the ultimate strength of the unirradiated specimens. (auth)

34931 (N-66-28417) A THEORETICAL AND EXPERIMENTAL STUDY OF RADIATION DAMAGE IN DRIFT-FIELD SOLAR CELLS. Annual Report. Baicker, J. A. (Princeton Research and Development Co., N. J.). May 10, 1966. Contract NAS5-9580. 47p. (NASA-CR-75688). CFSTI.

Results of a theoretical and experimental study of drift field solar cells are described. The objective of the program was a general comparison of drift field cells with conventional solar cells, and in particular to understand and to predict the radiation damage behavior of drift field cells. The work concentrated on two specific investigations: the current-voltage relationships in drift field cells compared with conventional cells, and the spectral response of the two types of cell. In both phases of the program detailed measurements were carried out at various sample temperatures, and in normal and irradiated cells. The temperatures were in the range from room temperature down to 77°K, and irradiations were with 1-MeV electrons and 3-MeV protons. The results of the investigations provide clear indications of the reasons for the failure of drift field cells to outlast conventional cells when they are operated in a radiation environment. (auth)

34932 (N-66-30186) RADIATION EFFECTS ON SILICON. Fourth Quarterly Progress Report, September 25–December 31, 1965. Wikner, E. G.; Snowden, D. P. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Jan. 10, 1966. Contract NAS7-289. 14p. (NASA-CR-76120). CFSTI.

Progress is reported on an investigation of radiation effects in Si solar cells. During this period the experimental setup to study microwave conductivity was modified to obtain improved low temperature operation of the sample holder and better accuracy in conductivity measurements. Modifications were also made in the cavity to be used for the microwave resonance studies. Preliminary experiments were initiated to determine the indirect production of the divacancy in p-type Si. (auth)

34933 (N-66-30276) RADIATION EFFECTS ON SILICON. Quarterly Progress Report No. 5, January 1–March 31, 1966. Wikner, E. G.; Naber, J. A.; Horriye, H. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Apr. 11, 1966. Contracts NAS7-289; DA-49-186-AMC-65(X). 14p. (NASA-CR-76119). CFSTI.

The electrical conductivity for n-type ultrapure Si was measured at 4 to 300°K. The transient conductivity was measured at 20° to 300°K at high injection levels. The results show that a quantitative determination of the temperature dependence of conductivity and transient conductivity is possible. The annealing characteristics of the divacancy formed at 80°K in p-type Si and the vacancy P complex formed at the same temperature in n-type were studied. For the divacancy, it was observed that there is at most a 10% increase in the number of centers after a 300° anneal. This signifies that there is a very small number of indirectly produced divacancies in the 80°K in B-doped Si. Finally, micro-

wave resonance studies were made to identify the recombination center responsible for the lifetime degradation. (auth)

34934 (NAA-SR-11519) IRRADIATION TEST OF SNAP 8 CANDIDATE SPRING MATERIALS. Cowgill, D. S.; Davies, N. F.; Kurzeka, W. J. (Atomics International, Canoga Park, Calif.). June 30, 1967. Contract AT(03-3)-701. 37p. Dep. CFSTI.

An experiment was conducted to determine the effects of long-term exposure to radiation, high temperature, and vacuum on the performance of two candidate SNAP spring materials. Five René 41 (Ni–Cr–Fe) and five Stauffer 880 (88Ta–12W) springs were tested under constant length conditions at temperatures between 700 and 1300°F. Radiation exposures varied from about 2×10^{17} to 3×10^{19} nvt fast neutrons (E > 0.1 MeV) and from about 5×10^{9} to 7.5×10^{10}R gamma. Vacuum levels were in the 10^{-4} torr range throughout the approximately 3250-hr experiment. The irradiated spring data were used to calculate the percentage of energy relaxation and percentage of force relaxation for comparison with non-nuclear test data. It was observed that, in all cases, the percent relaxation of irradiated René 41 springs was less than that of the unirradiated springs. No definite pattern was observable with the Stauffer 880 springs, except that high radiation levels increased the percent relaxation (both force and energy), although the effect was minimal at 1300°F. It was concluded, based on these tests, that René 41 springs are superior to Stauffer 880 springs at all test temperatures below ~1200°F. Above that temperature, the Stauffer 880 springs may be superior. (auth)

34935 (NRL-6512) FERROMAGNETIC RESONANCE OF ^{3}He-IRRADIATED THIN METAL FILMS. Bailey, G. C.; Schindler, A. I.; Meijer, P. H. E. (Naval Research Lab., Washington, D. C.). Nov. 10, 1966. 22p.

Ferromagnetic-resonance measurements at 9.5 GHz were made on a number of films of pure Fe and pure Ni, and alloys of Fe and Ni (Permalloy) before and after 2-MeV ^{3}He-particle irradiation. The film thicknesses varied from several hundred to several thousand angstroms. The ^{3}He-particle flux was about 3×10^{17}/cm^2 and, during irradiation, the film temperature did not exceed 81°C, as determined by thin-film thermocouples. The resonance field as a function of angle in the film plane, $H_0(\theta)$, and the half-width, ΔH, were measured at room temperature. In general, H_θ decreased (by about 2 oe, 35 oe, and 15 oe for the Fe, Permalloy, and Ni films, respectively) as a result of the irradiation, except for the composition range between 26 and 37 percent Ni, where H_θ increased. Also, the half-width generally decreased with irradiation, and the half-width change was smallest for compositions around 76 percent Ni. For the pure Fe and Ni films, the changes in H_θ can be attributed to changes in the radially isotropic stress in the plane of the film, $\Delta\sigma$, and in the uniaxial anisotropic field, ΔH_k, assuming that the saturation magnetostrictive constant, λ, and magnetization, M_s, do not change with irradiation. For the alloy films where irradiation-produced ordering may occur, M_s, as well as σ and H_k, may also change. The changes in H_θ were different for films of a given set evaporated onto various substrates (soft glass, fused quartz, single-crystal quartz, and Cu). Irradiating films in a saturating magnetic field, in the remanent state and in the demagnetized state gave H_k's which were larger, the larger the magnetic induction of the film during irradiation. Irradiating a film (or reirradiating a previously irradiated film) in a magnetic field also rotated the easy axis of the film into the direction of the field applied during irradiation. The rotation of the easy axis was observed over the entire composition range from pure Fe to pure Ni. For the pure Fe and pure Ni films, the rotation can be explained only on the basis of alignment of defects in the film during irradiation. For the Permalloy films, a short-range directional ordering effect might also apply. The variation with composition of the values of H_k after irradiation agree qualitatively with the values obtained by others using static techniques. (auth)

34936 (UCID-15135(Pt.1)) CONTRIBUTION TO THE 24TH MEETING OF THE HIGH-TEMPERATURE FUELS COMMITTEE, MAY 16–18, 1967, AT UNITED NUCLEAR CORPORATION, ELMSFORD, NEW YORK. Rothman, A. J. (comp.) (California Univ., Livermore. Lawrence Radiation Lab.). Apr. 19, 1967. Contract W-7405-eng-48. 25p. Dep. CFSTI.

Progress on studies of the synthesis and fabrication of UN is reported. Aspects discussed are N diffusion in UN, compressive creep, crystallogenics of UN and refractory materials, kinetics of nitriding, irradiation studies, particle size distribution, and solubility of W in Ag. (P.G.C.)

34937 (SC-T-67-0936) EXCERPTS FROM: THE EFFECT OF RADIATION ON THE PHYSICAL PROPERTIES AND STRUCTURE OF SOLID BODIES. Zakharov, A. I. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Usp. Fiz. Nauk, 57: 525-31; 535-6; 540-1; 546; 552-3; 573-6 (Dec. 1955). 18p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

Theoretical concepts that are currently used in explaining the behavior of solid bodies under the action of radiation are discussed. Radiation effects on Fe, Ni, and Co were investigated. Deuterons at 12 MeV caused an increase in the electric conductivity of Fe by 50%, while the resistance of Ni and Co rose by 10%. Under the effects of fast neutrons, the resistance of Fe increased by 10%, while the resistance of Ni rose by 1%. The results showed that with an identical irradiation dose, the change of properties is more significant in that particular metal that possesses a less dense crystalline structure. Radiation effects on structure and elastic properties of metals and alloys are compared with those obtained by others. (P.C.H.)

34938 MOBILITY OF INTERSTITIAL DEFECTS IN GOLD BOMBARDED WITH 270 eV GOLD IONS IN STAGE III. Thomas, L. E.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-3504. Phil. Mag., 15: 1137-54 (June 1967). (NYO-3504-11).

Shrinkage of vacancy stacking-fault tetrahedra in gold foils bombarded with 270-eV gold ions at temperatures between −90 and +100°C was studied using transmission electron microscopy. Interstitial defects were produced by replacement collision sequences initiated near the incident surface. The tetrahedra were partially annihilated by absorbing these defects and therefore served as indicators for long-range interstitial migration. By comparing the same tetrahedra in high resolution micrographs taken before and after bombardment, and after subsequent annealing, it was possible to determine unambiguously the tetrahedron shrinkage as a function of foil thickness. It was found that the tetrahedron shrinkage was independent of bombardment temperatures over the range −90 to +100°C and no shrinkage of tetrahedra or intrinsic Frank loops, or growth of interstitial clusters occurred when foils bombarded as low as −90°C were warmed to +30°C. Several additional specimens bombarded with 180-eV argon ions gave similar results. These results disagree with and supersede previously reported work. Various interstitial mobility models are considered. It is concluded that the interstitials are already mobile at the lowest temperatures investigated, i.e., at −90°C. (auth)(UK)

34939 INTERSTITIAL DEFECT CLUSTERS IN GOLD AFTER BOMBARDMENT WITH 270 eV GOLD IONS. Thomas, L. E.; Balluffi, R. W. (Cornell Univ., Ithaca, N. Y.). Contract AT(30-1)-3504. Phil. Mag., 15: 1117-35 (June 1967). (NYO-3504-10).

The formation of interstitial atom clusters in Au foils due to low-energy Au ion bombardment was investigated using transmission electron microscopy. Essentially no damage was produced in specimens having relatively clean surfaces by bombardments between +100 and −30°C. At lower bombardment temperatures in the range −30 to −90°C significant damage appeared at a density that increased gradually with decreasing temperature. The possible role of impurities in nucleating the interstitial damage clusters was investigated by bombarding specimens with Ar ions, and also by intentionally contaminating the specimen surfaces by exposure to electron or ion beams in the presence of hydrocarbon vapors prior to (or during) Au ion bombardment. The Ar bombardment and surface contamination caused considerably higher densities of damage than were found in the clean Au bombarded specimens. It was concluded that the damage in ion bombarded Au is formed by the aggregation of interstitial point defects driven into the foils by replacement collision sequences. However, the results indicate that damage is nucleated by hydrocarbon or Ar impurities, which are driven small distances into the specimen surfaces. Once nucleated, inward growth of clusters occurs by the accretion of point defects. A temperature dependence of the damage near 0°C in Ar ion bombarded specimens therefore cannot be taken as evidence for the onset of interstitial point-defect mobility near this temperature, as previously supposed by several investigators. In fact, the results are consistent with an interstitial which is already highly mobile below −90°C. (auth) (UK)

34940 HYDROGEN EMBRITTLEMENT IN IRRADIATED STEELS. Rossin, Albert David. Cleveland, Case Inst. of Tech., 1966. 150p.

Thesis.

H charging conditions that completely embrittle 4340 high strength steel have a negligible effect on 212-B pressure vessel steel in tensile and delayed failure tests. Much higher H charges reduce the notch tensile strength. Delayed failure is observed down to stresses 90% of the notch tensile strength of the hydrogenated metal. Tests on 212-B irradiated to give a 35% increase in strength and an NDT temperature shift of 200°F showed the same relationship between delayed failure limits and notch tensile strength. Catastrophic embrittlement due to H (like delayed failures at 25 to 50% of the notch tensile strength in 4340) is not observed in 212-B, even for irradiated material and with the high H contents studied. Therefore, catastrophic H embrittlement of a well-designed nuclear reactor pressure vessel is not believed

credible. The notch tensile strength of 4340 was reduced by irradiation, although the tensile strength increased. Catastrophic delayed failure still occurred with the sensitivity to H slightly reduced. (auth) (Disser. Abstr.)

34941 NEUTRON IRRADIATION OF PURE METALS AND Al–Zn ALLOYS. Horak, James Albert. Evanston, Ill., Northwestern Univ., 1966. 136p.

Thesis.

Changes occurring in electrical resistivity of pure metals and Al–Zn alloys under neutron irradiation were studied at 4 to 400°K. The initial resistivity that occurs in low temperature irradiation of metals was determined to be due to gamma ray heating. Residual resistivity rate of increase as a function of irradiation time near 4°K was the same for Al and the Al–Zn alloys, and recovery of irradiation-induced lattice defects was complete at 260°K in Al but zone growth continued in the alloy up to 400°K. (P.G.C.)

Ceramics and Cermets

Refer also to abstracts 34853, 34855, and 35701.

34942 ENGINEERING PROPERTIES OF SELECTED CERAMIC MATERIALS. Lynch, J. F.; Ruderer, C. G.; Duckworth, W. H. (eds.). Columbus, Ohio, The American Ceramic Society, Inc., 1966. 420p.

Engineering-property data of refractory ceramics, selected ceramic composite materials, refractory intermetallic compounds, and also selected metalloid elements are presented. Excluded are glasses, carbons, graphite, and those ceramic materials and intermetallic compounds with melting points below 2000°F. Data are those pertinent to structural engineering and include physical, thermal, and mechanical properties as well as information on resistance to thermal stress, oxidation, and corrosion. (1026 references). (P.C.S.)

Corrosion and Erosion

34943 OXIDATION KINETICS OF TUNGSTEN CARBIDE. Gimel'farb, F. A.; Zelikman, A. N. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met., No. 3, 63-6 (1967). (In Russian).

Kinetics of oxidation of WC was investigated using hot-pressed dense specimens and powder mixtures of WC. At temperatures from 500 to 900°C, the WC oxidized linearly with the activation energy 25.5 kcal/mole. In the presence of Fe the oxidized WC formed $FeWO_4$ and Fe_2WO_6. In the presence of Cu the intermediate phases formed a compound of probable composition Cu_2WO_4 with melting point at 610°C. (R.V.J.)

Preparation and Fabrication

34944 (BNWL-SA-1155) DEFORMATION AND BONDING MECHANISMS OF UO_2 DURING PNEUMATIC IMPACTION. Daniel, J. L.; Ishii, B.; Takahashi, S. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1966]. Contract AT(45-1)-1830. 18p. (CONF-670428-1). Dep. CFSTI.

From Annual Meeting of the Atomic Energy Society of Japan, Tokyo, Japan.

The use of pneumatic impaction for fabricating ceramic nuclear fuel materials was investigated. Radiography of impacted specimen cans were used to determine crystal positions. The results showed that high energy rate impaction and bonding occurs in two closely related states: deformation and densification of individual particles, leading to close conformation of component surfaces, an intimate contact between adjacent particles, and exclusion of interface porosity; and bonding of adjacent particles induced by the close surface contact resulting from the previous plastic deformation. (P.C.H.)

34945 (BNWL-SA-1223) PREPARATION OF SAMPLES FOR TRANSMISSION ELECTRON MICROSCOPY OF SINGLE PHASE AND MULTIPHASE CERAMICS. Mayhan, Shirley J.; Bauleke, M. P. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 15, 1967. Contract AT(45-1)-1830. 36p. (CONF-670536-1). Dep. CFSTI.

From Tri-Sections Annual Meeting of the American Ceramic Society, Yakima, Wash.

The problem of chemically thinning sintered and pneumatically impacted UO_2 is discussed. The material was cut about 20 mils thick and hand ground to about 5 mils. The slice was then broken into a chip of the proper size for the electron microscope specimen holder and the edges coated with a protective lacquer. The chip, held between stainless steel tweezers, was submerged into the polishing solution and agitated until desired thinness was reached. The composition of the polishing solution was: 10 ml acetic acid, 20 ml saturated chromic acid, 5 ml 48% HF, and 4 ml HNO_3. A mechanical thinning technique for multiphase nonmetals is also described. The specimen is mounted in clear epoxy, polished, and mount machined to within $\frac{1}{16}$ in. of unpolished specimen face. The polished face is mounted on plexiglass with low-temperature cement and the specimen thinned with diamond wheels, fine emery paper, and a vibratory polisher. It is removed from the mount, cleaned, and mounted on grids. (M.C.G.)

34946 (Y-DA-1733) PREPARATION OF CERAMIC URANIUM DIOXIDE COMPACTS. Trent, P. E. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). July 5, 1967. Contract W-7405-eng-26. 19p. (CONF-670626-1). Dep. CFSTI.

From American Ceramic Society Meeting, Gatlinburg, Tenn.

Experience in the fabrication of high density UO_2 compacts from a ceramic-grade UO_2 powder without the use of binders and lubricants and without the necessity for high-pressure pressing equipment is described. The pellets are crack free and have sharp edges and smooth surfaces without any chips. Sufficient experience was gained to make it possible to fill future orders for pellets that would have densities as low as 8.0 g/cc. (P.C.H.)

34947 INVESTIGATION OF THE BONDING MECHANISM BETWEEN METALS AND CERAMICS. I. CERAMIC-TO-METAL SEALS. II. CERAMIC-TO-METAL SEALS OF HEAVY METALS TYPE TO BERYLLIA CERAMICS. Helgesson, Claes I. Trans. Chalmers Univ. Technol., Gothenburg, No. 311, 1-121(1966).

Methods for bonding metals to ceramic materials are reviewed. A study of the bonding mechanism concentrating on metallizing with the aid of heavy metals and with active metals was carried out with emphasis on Mo–Mn mixtures. Tests were conducted mainly using pure Al_2O_3 but some BeO was used. Studies of the adherence as well as electron-probe microanalysis of the metallizing layers support the glass-penetration theory. No evidence for the penetration of Mo into BeO ceramics giving bonding of solid-state type as in the case of Al_2O_3 was found. (P.C.S.)

34948 FORMATION OF COATS IN SPRAYING OF TUNGSTEN ONTO GRAPHITE. Bobrov, G. V.; Privezentsev, V. I. Svar. Proizv., No. 6, 15-17(June 1967). (In Russian).

The process of plasma deposition of W coating was studied in order to determine the optimum parameters of coating techniques on graphite. In order to find the causes of defects appearing on the coated layers an analysis was made of the possible reactions of W particles with the gaseous phase and of the processes taking place on the coated graphite surfaces. A possibility of improving the quality of W coating by thermal treatment is discussed. (R.V.J.)

34949 OXIDATION RESISTANT, HIGH TEMPERATURE CERAMIC-TO-METAL SEAL COMPATIBLE WITH CESIUM. Hill, Russell J.; Knopp, C. F. (Avco Corp., Lowell, Mass.). Rev. Sci. Instrum., 38: 1067-8(Aug. 1967).

A method of making ceramic-to-metal seals is described. The technique is based on a Ni–Ti intermetallic compound which is ductile and has a wide composition range. The compound is used as a braze which wets ceramics, such as sapphire, very easily to form hermetic seals. The braze may be made in an Ar stream and does not rely on a vacuum. The seals can be made quickly and easily and are very stable towards liquid Cs, and may be used in air up to 800°C for extended periods of time. (auth)

34950 LARGE DIMENSIONAL FABRICATIONS FROM HIGH-MELTING CARBIDES. Ignat'ev, B. G.; Nezhevenko, L. B.; Poltoratskii, N. I.; Fomin, G. S.; Yakutovich, M. V. Ogneupory, No. 6, 49-52(June 1967). (In Russian).

Fabrication technology of large-scale products made of ZrC and NbC is described. The technology included preparation of the dross, preliminary hot casting or hot extrusion, and hot pressing in a vacuum at 2200°C. The described technology was used for producing articles with 96 to 97% theoretical density without external defects, which were checked by ultrasonic methods. (R.V.J.)

34951 IMPROVED PROCESS FOR THE PRODUCTION OF GRAPHITE. (to Pechiney Compagnie de Produits Chimiques et Electrometallurgiques). British Patent 858,667. Jan. 11, 1961. Priority date Feb. 29, 1956, France.

High purity graphite for nuclear reactors is produced from low ash petroleum coke or pitch coke in an electric resistance furnace. The carbonaceous material to be graphitized is used as the resistor and is separated from undesired impurities such as SiO_2 and SiC by a layer of granular coke. Halogen-containing compounds, one of which is a compound of F, as NaF, reacting when the temperature exceeds 2000°C, are used as vapor purifying agents. (P.G.C.)

Properties Evaluations

Refer also to abstracts 34865, 34896, 34909, and 34936.

34952 (AECL–2698) THE DEVELOPMENT OF TEXTURE IN ZIRCONIUM ALLOY TUBES AND ITS EFFECT ON MECHANICAL PROPERTIES. Cheadle, B. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). Mar. 1967. 20p. Dep. CFSTI.

The development of texture in Zr alloy tubes is described and rules formulated that allow the control of texture in the various fabrication processes. The mechanical properties of Zircaloy-2 fuel sheathing are shown to be affected by texture and a single preferred orientation with the principal hexagonal axes in the radial direction gives the best combination of strength and ductility. (auth)

34953 (CEA–R–3179) CONTRIBUTION A L'ETUDE DE L'AUTO-DIFFUSION DE L'OXYGENE DANS LES OXYDES REFRACTAIRES: APPLICATION AU DIOXYDE D'URANIUM. (Contribution to the Study of Oxygen Self-Diffusion in Refractory Oxides: Application to Uranium Dioxide). Contamin, Pierre; Stefani, Rene (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Apr. 1967. 32p. (In French). Dep.

A method is described for O_2 self-diffusion profile determination in solid UO_2 samples, with a possible extension to other refractory oxides. A thin (10 to 20 microns) layer of enriched oxide $U^{18}O_2$ ($^{18}O/^{16}O + {}^{18}O = 75\%$) is allowed to diffuse into a semi-infinite medium of natural UO_2; upon grinding successive layers of definite thickness, the isotope concentration ratio is determined by spark-source mass-spectrometric analysis on the surface of the massive sample. The spark trace does not exceed a depth of 10 microns and the diffusion zone covers more than 50 microns, corresponding to a variation of the concentration ratio larger than 100. This method gave values for self-diffusion of $(1.3 \pm 0.2) \times 10^{-10}$ and $(3.4 \pm 0.9) \times 10^{-10}$ cm^2/sec for 2 experiments at 1020°C. (auth)

34954 (COO–716–028) THERMODYNAMICS OF VAPORIZATION OF SAMARIUM AND YTTERBIUM DICARBIDE. Eick, H. A.; Haschke, J. M.; Pilato, P. A. (Michigan State Univ., East Lansing. Dept. of Chemistry). May 1, 1967. Contract AT(11-1)-716. 7p. (CONF-670913-1). DTIE.

From Symposium on New Investigations in Thermodynamics, Thermochemistry, and Transport Properties, Heidelberg, Germany.

The evaporation behavior of the dicarbides of Eu, Gd, Ho, La, Nd, and Y was investigated by chemical analysis, x-ray spectroscopy, x-ray fluorescence analysis, and mass spectrometry. It was determined that the chief factor in the relationship between the vapor pressure of the metal ion and the dicarbide is the vapor pressure of the metal itself. (P.G.C.)

34955 (EURAEC–1863) SPECIFIC SURFACE MEASUREMENTS OF SINTERED UO_2 SAMPLES BY THE BET METHOD USING ^{133}Xe. Special Report No. 2, R/505. Giarda, L.; Knappik, P. (comps.) (Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari). Apr. 1967. Contract 043/65 TEEI(RD). 63p. (EUR–3367). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Specific surface measurements were performed on UO_2 of different densities by the BET method; the pressure was measured by recording the radioactivity of ^{133}Xe. The values obtained were in the range 0.85 to 2.2 cm^2/g for theoretical densities of 92% and 2.0 to 6.7 cm^2/g for theoretical densities of 95%. (auth)

34956 (LA–3705) DIRECT CARBON REPLICATION OF URANIUM TETRAFLUORIDE FILMS ON URANIUM DIOXIDE. Ellis, W. P.; Douglass, Dana L. (Los Alamos Scientific Lab., N. Mex.). Apr. 3, 1967. Contract W-7405-eng-36. 12p. Dep. CFSTI.

Direct carbon replicas of bare UO_2 and of UF_4 films formed on UO_2 by reaction with HF(g) were examined by electron microscopy. In contrast with the collodion replication study reported in LA-3183, C replication provides a correlation between optical blemishes in fluoride interference layers and surface morphology of the film. Observations indicate a growth of microcrystallites within the fluoride layer at reaction temperatures above 300°C. (auth)

34957 (LA–DC–8012) THERMODYNAMICS OF THE PLUTONIUM CARBIDES. Olson, W. M.; Mulford, R. N. R. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 19p. (CONF-670915-1). Dep. CFSTI.

From Symposium on Thermodynamics of Nuclear Materials with Emphasis on Solution Systems, Vienna, Austria.

The results of volatility measurements on samples from portions of the Pu–C system and attempts to derive the thermodynamic properties of some of the Pu carbide phases are presented. The values for thermodynamic functions of the plutonium carbides were compared with those of the isostructural uranium carbides. The absolute entropies of $UC_{1.5}$ and $PuC_{1.5}$ agreed very closely, but the absolute entropy of $PuC_{0.87}$ was substantially higher than that of $UC_{1.0}$. The results are discussed. (P.C.H.)

34958 SOME PROPERTIES OF SINTERED WC–TaC–10 PERCENT Co ALLOYS. Suzuki, Hisashi; Yamamoto, Takaharu; Kawakatsu, Ichiro (Tokyo Univ.). Nippon Kinzoku Gakkaishi, 31: 585-9(1967). (In Japanese).

Properties of WC–TaC–10% Co alloys having various C contents (vacuum-sintered at 1375°C for 1.5 hr) were examined. Results indicated that the lattice parameter of the binder phase and the magnetic saturation of WC–TaC–Co alloys, except the alloys having extremely high TaC, changed regularly in the (WC + TaC + γ) three-phase region, in a way similar to the properties of WC–Co alloys did in the (WC + γ) two-phase region. The amount of dissolved TaC into the binder phase was found to be very small. The C/Ta ratio of the TaC phase changed according to the change in C content. Therefore, the three-phase region of WC–TaC–Co alloys extended with increasing TaC content, although the extension was extremely small compared with the alloys containing titanium carbide. The phase boundary between the (WC + TaC + γ) three-phase and (TaC + γ) two-phase regions was found at the content of more than about 95% TaC in carbide; the content of TaC indicating the point on the boundary, however, increased by a small amount with increasing C content. When the content of TaC increased, the TaC phase was apt to coarsen and to form a carbide skeleton. A remarkable grain growth of TaC was observed in the low C TaC–10% Co alloys. The mechanical properties of WC–TaC–Co alloys deteriorated with increasing TaC content. (auth)

34959 PRESSURE-TEMPERATURE PHASE DIAGRAM OF URANIUM METAL. Asami, Naoto; Yamada, Masao; Takahashi, Shuichiro (Mitsubishi Atomic Power Industries Inc., Omiya, Japan). Nippon Kinzoku Gakkaishi, 31: 389-94(1967). (In Japanese).

The electrical resistance changes of U metal during the transformations between the α (orthorhombic), β (tetragonal), γ (body-centered cubic), and liquid phases were studied quantitatively up to 80 kb, 1200°C in cooling and heating at rates of 2 ~ 4°C/sec by utilizing a modified girdle type apparatus. The samples were monitored by thermocouples and potential probes. The P.T. locations of the (α,β), (β,γ), (γ,liquid), and (α,γ) phase boundaries, and (α-β-γ) triple point were determined. The equilibrium (α-β-γ) triple point was placed at 29.8 ± 1.2 kb, 798 ± 5°C. The hysteresis intervals at the heating and cooling runs for α-β, β-γ, and α-γ transformations under high pressures were about 33, 21, and 17°C, respectively, and these values were nearly the same as the hysteresis expected at zero pressure. The initial slope of (α,β) and (β,γ) phase boundaries agreed well with the calculated T vs P curve based on the zero pressure thermodynamic consideration. The volume change accompanied with melting was calculated as 0.49 cm^3/mole from the initial slope of (γ,liquid) phase boundary. (auth)

34960 ON THE MECHANICAL PROPERTIES OF NIOBIUM–HYDROGEN ALLOYS. Sasaki, Yasuo; Kimura, Hirozo; Uehara, Shigeaki (National Research Inst. for Metals, Tokyo). Nippon Kinzoku Gakkaishi, 31: 401-5(1967). (In Japanese).

Tensile and bending properties of Nb containing H_2 up to 8 at. % were investigated. It was found that hydrogen has a pronounced effect on the elongation, yield stress, and bending properties of Nb. Nb–H alloys were made by heating Nb in purified H_2 at 1 atm pressure at 450°C for several hours. Plate-like and lenticular hydrides were observed in all specimens used for the present experiments. The yield stress and elongation of specimens were measured with Instron's type test machine at room temperature, –75 and –195°C. The yield stress increased gradually with increasing H contents. Elongation decreased with increasing H contents and Nb–2.05 at. % H specimens showed 17% elongation. Bend angle tests were carried out with Chevenard's testing machine at room temperature and a marked effect of H on the bending properties was found. The bend angle decreased abruptly to zero in alloys containing more than 2.05 at. % H. Alloys containing less than 1.63 at. % H showed ductile deformation in the bend test. (auth)

34961 DIFFUSION OF XENON IN URANIUM MONOCARBIDE. Shaked, H.; Olander, D. R.; Pigford, T. H. (Univ. of California, Berkeley). Nucl. Sci. Eng., 29: 122-30(July 1967). (UCRL–17271).

The lattice diffusion coefficient of ^{133}Xe in cast UC was measured by postirradiation anneal experiments at 1000 to 2000°C. The experimental results were analyzed by a small-time solution of Fick's law in which the effect of depletion of the surface layer due to recoil was incorporated in the initial distribution. The diffusion coefficient of specimens consisting of large grains (700 to 1000 μ) was best approximated by $D = (1.17 \pm 0.16)10^{-6} \exp[-(54900 \pm$

1200)/RT] at 1000 to 2000°C. Specimens with small grains (20 to 150 μ) exhibited the same diffusion coefficient as the large grain samples above 1500°C. Below 1500°C, diffusivities in small-grained specimens varied widely, indicating dependence on grain size and, hence, the existence of appreciable grain-boundary diffusion. (auth)

Structure and Phase Studies

Refer also to abstract 34926.

34962 (RFP-927) PROPERTIES OF PLUTONIUM OXIDE. PART II. Molen, Garrel F.; White, Robert D. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). July 12, 1967. Contract AT(29-1)-1106. 11p. Dep. CFSTI.

The effect of the maximum exposure temperature and the time of exposure on the properties of PuO_2 are described. Results showed that temperature, and the interaction of temperature and time, had a significant effect on the properties measured. Time alone did not have a significant effect on the properties measured. (auth)

34963 URANIUM–NITROGEN SYSTEM. Katsura, Masahiro; Sano, Tadao (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo), 4: 283-8(June 1967).

The heat of formation of U_2N_3 was evaluated. The U_2N_3 phase is known to form a single solid solution with UN_2, while the U_2N_3 compound with minimum N/U ratio is in equilibrium with UN under a given condition of temperature. The heat of formation for the terminal U_2N_3 was calculated from measured pressure of decomposition from U_2N_3 to UN, by Gross, et al., Lapat, et al., and Bauer, et al. The decomposition pressure was measured by a simple Sievert apparatus with an oil manometer. From the nitrogen pressure-composition isotherms obtained by Lapat, et al., the interaction energies for U–U, U–N, and N–N were calculated statistico-thermodynamically. Using these values, the heat of formation for the single phase U_2N_3 was determined to be $\Delta H^0_{(U_2N_{3+x})} = -172.2 - 48.9x + 25.4x^2$ kcal/mol. (auth)

34964 STUDY OF Nb–Zr–Hf–C SYSTEMS. Fedorov, T. F.; Gladyshevskii, E. I.; Popova, N. M. pp 127-35 of Eksperimental'naya Tekhnika i Metody Vysokotemperaturnykh Izmerenii. Samarin, A. M. (ed.). Moscow, Izdatel'stvo Nauka, 1966. (In Russian).

Microstructure and x-ray analyses were made of ZrC–HfC, ZrC–NbC, and HfC–NbC systems and phase diagrams were constructed for the ternary and quaternary systems. Phase compositions and lattice parameters of sintered Zr–Nb–C and ZrC–HfC and of melted Zr–Nb–C are tabulated. (R.V.J.)

34965 NON-STOICHEIOMETRY IN TERNARY OXIDES WITH THE FLUORITE STRUCTURE. Hoch, M.; Yoon, H. S.; Silberstein, A. (Univ. of Cincinnati). Proc. Brit. Ceramic Soc., No. 8, 247-57(June 1967).

Ternary oxides with the fluorite structure can be written as $Me'_yMe''_{1-y}O_{2+x}$ (one cation being in two valency states), or as a solution of oxides AO_m, BO_n, and CO_r. The cation sites which form a fcc structure are completely filled. If $x > 0$, the excess anions are accommodated in octahedral interstices; if $x < 0$, some of the tetrahedral sites are empty. When $x > 0$, a large single-phase fluorite structure exists, as in $U_{1-y}Ce_yO_{2+x}$ and $U_{1-y}Th_yO_{2+x}$. When $x < 0$ either a single phase with a defect fluorite structure is present, or two phases, each having a defect fluorite structure, co-exist. The latter occurs if a defect fluorite phase containing only one cation in two valency states is possible (e.g., $CeO_2-CeO_{1.5}$). The defect oxygen sub-lattice, in this case, must be considered as forming complexes between the vacancy and oxygen ions; these complexes are responsible for the co-existence of two defect fluorite phases. (UK) (auth)

34966 ON THE MICROSTRUCTURE CHANGE INDUCED BY CENTER MELTING AND THE FORMATION OF CENTRAL VOIDS IN POWDER COMPACTED UO_2 FUEL. Kubota, Tadashi; Seki, Yoshinobu; Takahashi, Shuichiro (Mitsubishi Atomic Power Industry Inc., Omiya, Japan). Nippon Kinzoku Gakkaishi, 31: 406-12(1967). (In Japanese).

The microstructural changes induced by center melting and the formation of central voids in powder compacted UO_2 fuel were studied by center-line heating in order to obtain information for interpreting the data of in-pile tests which were done in parallel with this experiment. Single crystalline columnar grains and equi-axed grains were grown in the molten region during the heating process and solidified by the subsequent cooling process, while columnar grains having lenticular voids were grown in the region kept in the solid state throughout the experiment. Both types of columnar grains showed different growth patterns depending upon the change in the extent of the molten zone. When the molten zone was large, large single crystalline columnar grains were grown in the central region, while small columnar grains having lenticular voids were grown in the region surrounding the large central grains. When the molten zone was small, large columnar grains having lenticular voids were grown in the central region. The central voids were grown not only by melting-down but also by shrinkage of powder compact associated with sintering when the temperature of central region was high enough to induce the sintering of UO_2. (auth)

34967 REACTIONS OF COMPOUNDS IN THE Nb–C–O SYSTEM WITH CO OR CO_2. Kimura, Hirozo; Sasaki, Yasuo; Uehara, Shigeaki (National Research Inst. for Metals, Tokyo). Nippon Kinzoku Gakkaishi, 31: 395-400(1967). (In Japanese).

Reactions of compounds in the Nb–C–O system with CO or CO_2 were investigated. Reactions of solid phases, such as Nb, NbO, NbC, and Nb_2O_5, with CO, CO_2, or a gaseous mixture of CO and CO_2, up to 1400°C were studied by the measurement of weight changes, x-ray analysis, and chemical analysis. In the reactions of Nb or NbO with CO, mixtures of NbO_2 and NbC were obtained as final products according to the following gross reactions: $3\,Nb + 2\,CO \rightarrow 2\,NbC + NbO_2$ and $3\,NbO + CO \rightarrow 2\,NbO_2 + NbC$. In the case of Nb_2O_5 with CO, NbO_2 was obtained as a reduction product by the following equation, $Nb_2O_5 + CO \rightarrow 2\,NbO_2 + CO_2$. Little weight change was observed in the reaction of NbC with CO. CO_2 acted as an oxidizing agent and Nb_2O_5 was obtained in all cases with the CO_2 reaction. C and O_2 increased during the arc melting process in CO atmosphere in the specimen containing more than 80 at. % Nb. Excepting the above case, C and O_2 were found to decrease in most specimens during the arc melting process in CO or Ar atmosphere, and the rate of decrease is remarkable in the specimens containing O_2 and C at the ratio of about one to one. (auth)

34968 ETCHING STUDIES OF BERYLLIUM OXIDE CRYSTALS. Austerman, S. B. (Atomics International, Canoga Park, Calif.); Newkirk, J. B.; Smith, D. K.; Newkirk, H. W. J. Mater. Sci., 2: 378-87(July 1967).

Chemical etching behavior of BeO crystals was investigated for selected etchants ranging from basic to acidic in nature. Surface-emergent defects (dislocations, enclosed Pt crystals, point-defect concentrations, surface mechanical damage, twin boundaries) gave rise to recognizable etch figures characteristic of etchant, defect type, and orientation of emergence face. Gross etching rates (in the absence of surface-emergent defects) were strongly anisotropic for both basic and acidic etchants, reflecting the crystallographic polarity of the BeO crystal structure; intermediate etchants give nearly isotropic etching. The details of gross and figure etching are described. (auth)

34969 DIELECTRIC CONSTANT OF ZIRCONIA. Harrop, P. J.; Wanklyn, J. N. (Atomic Energy Research Establishment, Harwell, Eng.). Brit. J. Appl. Phys., 18: 739-42(June 1967).

The dielectric constant of ZrO_2 was determined for the first time on single-crystal material. A value of 22 ± 3 is obtained, almost independent of frequency from 100 c/s to 20 kc/s. (auth)

34970 DUCTILE BRITTLE TRANSITION IN THE NIOBIUM HYDROGEN SYSTEM. Benson, Ray Braman, Jr. Berkeley, Calif., Univ. of California, 1966. 65p.

Thesis.

The ductile brittle transition in supposedly solid solution Nb–H alloys results from the formation of a second phase structure at low temperatures, for which the driving force is the strong temperature dependent solubility of H in Nb below room temperature. Optical and replica fractography were used to study the crack propagation mechanism. Examination of the cleavage surface of a Nb 1 at. % H single crystal tested at –44°C showed no evidence of a second phase structure, while a crystal with the same H content tested at –117°C revealed definite evidence of a second phase structure. The critical propagation step in the embrittled material was the formation of a microcrack of a critical size, which acted as a stress concentrator to nucleate microcracks at the second phase structure. The main crack then propagated by the joining of microcracks to each other, and to the main crack front. Transmission electron microscopy and electron diffraction were employed to study the second phase structures in this system. The first structure to form was a distorted bcc structure which resulted from the ordering of interstitial H atoms. The fracture nuclei appear to be groups of impinging lenticular domains of different orientations with this distorted bcc structure. (auth) (Disser. Abstr.)

Radiation Effects

Refer also to abstracts 34512, 34928, and 34936.

34971 (AD-641673) STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS.

AND MATERIALS (SCORRE). Final Report, June 15, 1964–July 15, 1966. Report No. 6. Boczar, Paul G.; Boyd, Gilbert E.; Cordwell, Wayne A.; Frankovsky, Frank A. (International Business Machines Corp., Owego, N. Y. Electronics Systems Center). Oct. 1966. Contract DA-28-043-AMC-00212(E). 73p. (ECOM-00212-F). CFSTI.

Radiation-induced behavior of TaO_2, mica, ceramics, Mylar, glass, and polystyrene capacitors, using results obtained at several sources, is described. Included are discussions of experimental techniques at each radiation source, including measurement of circuits, components, dosimetry, and variation of circuit and radiation parameters, results from SPRF, LINAC, and AFXR tests describing the dependencies of induced current for the irradiated dielectric, interpretation of these results in terms of appropriate models and irradiation and circuit parameters, comparison of the effects observed at each radiation source, description of tests on magnetics and test results. (P.G.C.)

34972 (AD–643652) STUDY FOR GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION. Quarterly Progress Report No. 6, June 15–September 14, 1966. Raymond, James P.; Johnson, Robert E. (Nortronics, Newbury Park, Calif.). Dec. 1966. Contract DA-28-043-AMC-00423(E). 100p. (ARD–66–62R; ECOM–00423–6). CFSTI.

The saturation-inclusive bipolar transistor representation was refined and written into a computer code to allow detailed comparison of analytical and experimental results. Electrical and radiation-induced saturated switching responses were calculated from electrical parameter measurements. The agreement between calculated and experimental results is good. The lumped-model analysis of the monolithic circuit elements was extended to the detailed qualitative characteristics of junction-isolated and dielectrically-isolated resistor and transistor elements. Comparison is made between the results of the lumped-model analysis and known solutions of the differential equation representation of the devices. (auth)

34973 (CEA-R-3223) COMPORTEMENT A L'IRRADIATION DE CARBURES, NITRURES ET CARBONITRURES MIXTES D'URANIUM ET DE PLUTONIUM. (Irradiation Behaviour of Mixed Uranium–Plutonium Carbides, Nitrides, and Carbo–Nitrides). Mikaieloff, Hubert; Mustelier, Jean-Pierre; Bloch, Jacqueline; Leclere, Jacques; Hayet, Lucien (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1967. 61p. (In French). (EUR–3447.f). Dep.

In the framework of the research program on fast reactor fuels two irradiation experiments were carried out on mixed uranium–plutonium carbides, nitrides and carbonitrides. In the first experiment carried out with thermal neutrons, the fuel consisted of sintered pellets sheathed in a stainless steel can with a small gap filled with He. There were three PuC–UC samples and the maximum linear power was 715 W/cm. After a burnup slightly lower than 20,000 MWd/t, a swelling of the fuel that had ruptured the cans was observed. In the second experiment carried out in the BR-2 reactor with epithermal neutrons, the samples consisted of sintered pellets sodium bonded in a stainless steel tube. There were three samples containing different fuels and the linear power varied between 1130 and 1820 W/cm. Post-irradiation examination after a maximal burnup of 1550 MWd/t showed that the behavior of the three fuel elements was satisfactory. (auth)

34974 (N–67–12164) RADIATION EFFECTS ON SILICON. Quarterly Progress Report, July 1–September 30, 1966. Naber, J. A.; Wikner, E. G. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Oct. 12, 1966. Contract NAS7-289. 10p. (NASA-CR–80138; GACD–6249; QPR–7). CFSTI.

Electrical conductivity in high-purity n-type Si was investigated by the microwave technique after irradiation by 30 MeV electrons at room temperature. Electron-spin resonance studies were made on high-resistivity material to establish a correlation between the microwave resonance and carrier lifetime studies. Further experiments were performed on the formation of the Si-G8 center at 80°K, with subsequent annealing to 300°K. (auth)

Plastics and Other Materials

Refer to abstracts 34312 and 34853.

PHYSICS (GENERAL)

Astrophysics

Refer also to abstracts 35047, 35050, 35051, 35079, 35277, and 35438.

34975 (NP–16781) RESEARCH REPORT OF THE DEPARTMENT OF PHYSICS, UNIVERSITY COLLEGE, LONDON. SESSION 1965–66. (University Coll., London (England). Dept. of Physics). 84p. Dep. CFSTI.

Separate abstracts are prepared for each of the 5 sections presented. (B.G.D.)

For abstracts of individual sections see: 34470, 34976, 35013, 35079, and 35247.

34976 (NP–16781, 55-67) THEORETICAL PHYSICS. (University Coll., London (England). Dept. of Physics).

Brief summaries are given in theoretical physics under the broad categories of atomic physics and astrophysics, high-energy physics, and general physics. Publications by members of theoretical group are cited. (W.D.M.)

34977 SOLAR WIND DEGRADATION OF INTERPLANETARY DUST. Carpenter, D. G.; Pastusek, Robert R. (National Center for Atmospheric Research, Boulder, Colo.). Planet. Space Sci., 15: 593-8(Apr. 1967).

The effect of the solar wind on the disposition of uncharged interplanetary dust particles is considered. The blowout dimension determined in this fashion is about 10^{-3} the dimension which exists for photon radiation pressure alone, and is therefore negligible. The solar wind also removes orbital momentum from the dust by collision, causing the dust to spiral inward. The relative orbital momentum of the wind to the dust is found using experimental data and Parker's Model. At 1 au heliocentric, the outward directed plasma speed is taken to be 5.00×10^5 m/sec and the density 5×10^6 positive ions/m^3. The solar-wind-induced dust particle lifetime (in years) is then $18 \times 10^8\ r_d \rho_d\ (R^2 - 0.00018)$ where r_d and ρ_d are dust particle radius and density respectively (MKS), and R is the dust particle's initial heliocentric distance in AU. This compares favorably with earlier work of Whipple, (Astrophys. J., 121: 750-70(1955)) provided his results are modified to account for the solar wind alpha particle component. Both Whipple's work and this paper are concerned with the extreme case of uncharged dust particles; as such, the times obtained are much greater than those resulting from Opik's (Irish Astr. J., 4: 84-135 (1956)) work with charged dust particles. Reality should lie between the two extremes. When the Poynting–Robertson effect and the solar wind are both applied, the dust removal time is changed from $T = 7 \times 10^5\ r_d \rho_d\ (R^2)$, for the Poynting–Robertson effect alone, to $T = 5 \times 10^5\ r_d \rho_d\ (R^2)$. (auth) (UK)

34978 STELLAR ACCRETION AND X-RAY EMISSION. Cameron, A. G. W. (Yeshiva Univ., New York. Goddard Space Flight Center, New York); Mock, M. Nature (London), 215: 464-6(July 29, 1967).

Shklovsky has suggested that the Scorpius x-ray source is a binary pair and that the x radiation arises from the collision of material from a giant star with a neutron star. The theoretical complications of such a model are found not to match actual measurements and it is suggested that the bremsstrahlung effect occurs between a giant star and a white dwarf. (auth) (UK)

34979 SOLAR X RAYS IN THE WAVELENGTH BAND 44 TO 60 A OBSERVED BY THE U. S. NRL SATELLITE 1965-16D AND ATMOSPHERIC OPTICAL DENSITIES DEDUCED FROM THESE OBSERVATIONS. Venables, F. H. (Science Research Council, Ditton Park, Eng.). Planet. Space Sci., 15: 681-8(Apr. 1967).

Measurements of solar x rays in the wavelength band 44 to 60 Å were obtained from telemetry, recorded at the Winkfield STADAN Station during the period April to July 1965, from the U. S. Naval Research Laboratory's Solar Radiation Satellite 1965–16D. The fluxes observed (in units of 10^{-2} erg cm^{-2} sec^{-1}) were 3 to 4 during April and May, and 6 to 13 during June and July, compared with 1 to 4 during 1964. The fluxes were correlated with values of 10.7 cm solar radio noise flux. Studies of the absorption of these x rays, in the atmosphere between 160- and 260-km altitude, have shown day-to-day changes of optical density to be not greater than 1.6:1 on most occasions during April and May 1965. A few results have shown larger apparent changes, at least part of which must be attributed to atmospheric variations. (auth) (UK)

34980 EMISSION-LINE VARIABILITY AND DISTANCE OF QUASARS. Pfleiderer, J.; Grewing, M. (Astronomische Inst., Bonn). Science, 157: 544-5(Aug. 4, 1967).

The radius of the line-emitting region in quasars is larger than 1 parsec for the cosmological hypothesis and smaller than 1 parsec for the local hypothesis. Variability in emission lines has been reported but not proved beyond doubt. Its time scale would be a direct observational indicator of this radius and would add an important element to the discussion of the origin of quasars. Objects that are variable in their optical continuum seem to be the most promising ones to look at for line variations, and they should be observed spectroscopically at regular intervals. (auth)

34981 CENTER-TO-LIMB VARIATIONS OF THE FRAUNHOFER LINES IN THE SPECTRAL INTERVAL 4000 TO 5000 A OBSERVED DURING THE SOLAR ECLIPSE OF MAY 20, 1966. Calamai, Giovanni; De Gregorio, Piero; Falciani, Roberto; Righini, Alberto; Rigutti, Mario. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 41: 468-71(Dec. 1966). (In Italian).

A concise description is given of the instrumentation used during the solar eclipse of May 20, 1966, to observe the center-to-limb variations of solar spectral line in the range from λ 4000 to λ 5000 Å. A brief account of the researches now in progress with the experimental data obtained during the eclipse is also given. (auth)

34982 RED SHIFT OF THE QUASI-STELLAR OBJECTS. Barbieri, Cesare. Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 41: 472-5(Dec. 1966).

An attempt is made to reconcile the local and cosmological hypotheses of quasars by assuming that a large part of the red shift is gravitational and using the available observational data to deduce distance, mass, and radius of the resulting model. It is concluded that the quasars are the parents of the galaxies. (W.D.M.)

34983 DISCOVERY OF AN INFRARED NEBULA IN ORION. Kleinmann, D. E. (Rice Univ., Houston, Tex.); Low, F. J. Astrophys. J., 149: L1-4(July 1967).

Observations at 22 μ have led to the discovery of an extended source of very low temperature located in the Orion Nebula (NGC 1976) and separated 20″ from the point source found by Becklin and Neugebauer (1967). This appears to be the first direct observation of an interstellar cloud undergoing rapid contraction and evolution. Presently determined parameters are summarized and plates show the positions of the two infrared objects as determined by measuring the offsets from θ^1(C) Ori, the brightest of the Trapezium stars. (W.D.M.)

34984 POLARIZATION OF THE TAURUS INFRARED SOURCE. Appenzeller, Immo; O'Dell, C. R. (Univ. of Chicago). Astrophys. J., 149: L5-6(July 1967).

Very high intrinsic polarization of the Taurus infrared source has been found. This observation confirms and extends the work of Zappala on late-type variable stars that are significantly but not as strongly polarized. If this polarization arises from particle alignment close to the star, then the self-reddening of the object must be appreciable. (auth)

34985 PHENOMENOLOGICAL LIMITS ON THE ABSORBING REGIONS OF QUASI-STELLAR SOURCES. Bahcall, John N. (California Inst. of Tech., Pasadena). Astrophys. J., 149: L7-9(July 1967).

It is shown how an analysis of the absorption lines in a quasi-stellar source can be used to obtain estimates of either (i) the particle density in the absorbing region or (ii) the distance between continuum source and absorber. First the implications of the observed fine structure in the Si II absorption lines are presented and then the implications of absorption lines arising from metastable states of C III and S II are discussed. (W.D.M.)

34986 AN ANALYSIS OF THE ABSORPTION SPECTRUM OF 3C 191. Bahcall, John N.; Sargent, Wallace L. W.; Schmidt, Maarten (California Inst. of Tech., Pasadena. Mount Wilson Observatory, Pasadena, Calif. Palomar Observatory, Pasadena, Calif. Carnegie Institution of Washington, D. C.). Astrophys. J., 149: L11-15(July 1967).

An analysis of a 193 Å/mm spectrum of 3C 191 is reported. This relatively high dispersion for such a faint object was sought in order to investigate the relative intensity of different fine-structure lines in absorption. The principal results of the analysis are discussed. The spectrogram was obtained Jan. 13, 1967, at the prime focus of the 200-inch telescope on baked IIaO emulsion. The exposure time was 8½ hours and the object was trailed along the slit to produce a width on the plate of 0.10 mm. Density tracings of the spectrum and of the night sky are shown and the principal quantities measured on the spectrogram are given. (W.D.M.)

34987 POLARIMETRIC OBSERVATIONS OF 14 QUASI-STELLAR OBJECTS. Appenzeller, I.; Hiltner, W. A. (Univ. of Chicago). Astrophys. J., 149: L17-18(July 1967).

New polarimetric observations of 14 quasars were obtained in March 1967, with the 82-inch reflector of the McDonald Observatory. A pulse-counting two-cell polarimeter with fixed photocells and a rotatable achromatic half-wave plate was used. The total observing time for each object varied between 10 and 50 min. No filter was used and the maximum spectral response of the instrument was near 4200 Å. Results indicate that a small intrinsic polarization is a common feature of quasars. (W.D.M.)

34988 SECULAR BEHAVIOR OF A BLUE OBJECT NEAR CYGNUS X-2. Usher, Peter D. (American Science and Engineering, Inc., Cambridge, Mass.). Astrophys. J., 149: L19-20 (July 1967).

A candidate for the source of x rays from Cyg X-2 has recently been identified. Under the working hypothesis that this object is similar in its optical properties to the only identified starlike x-ray source Sco X-1, plates from the Harvard collection were inspected and the candidate object was found to be variable with a range of about 1 mag. Secular behavior of the object is reported. (W.D.M.)

34989 OBSERVATION OF THE 94α AND 148δ HYDROGEN AND 94α HELIUM EMISSION LINES IN THE ORION NEBULA. Gordon, M. A.; Meeks, M. L. (Massachusetts Inst. of Tech., Lexington). Astrophys. J., 149: L21-5(July 1967).

Observations of recombination lines near 7.8 GHz show line profiles to be nearly Gaussian and the gas to be out of thermodynamic equilibrium. Comparison of helium and hydrogen lines gives a temperature of 6653 ± 1010°K. (auth)

34990 PARTIAL MASER ACTION IN RADIO FREQUENCY LINES OF HYDROGEN. Binh-Dy-Hoang; McCarroll, R. (Observatoire de Paris, Meudon). Astrophys. J., 149: L27-8 (July 1967).

Goldberg (1966) has shown that small departures of the level populations from thermal equilibrium can lead to a considerable enhancement of the stimulated emission contribution to the rf emissions from H(II) regions due to transitions between adjacent highly excited states. Electron densities in the Orion Nebula are calculated, following Seaton's (1964) general procedure. (W.D.M.)

34991 PHOTODESTRUCTION OF HYDROGEN MOLECULES IN H I REGIONS. Stecher, Theodore P.; Williams, David A. (Goddard Space Flight Center, Greenbelt, Md.). Astrophys. J., 149: L29-30(July 1967).

A photodestruction mechanism is found that gives a lifetime of $\sim 10^{10}$ sec for H_2 in H(I) regions of the interstellar medium. Coupled with production, this gives a mean density of $\sim 10^{-7}$ cm^{-3} for H_2 which is a factor of $\sim 10^7$ less than that previously obtained. (auth)

34992 Kα X-RAY-TYPE TRANSITIONS IN THE SOLAR ATMOSPHERE AND LABORATORY PLASMA. Blake, R. L.; House, L. L. (High Altitude Observatory, Boulder, Colo.). Astrophys. J., 149: L33-5(July 1967).

A recent observation of the solar x-ray spectrum has led to the suggestion that two lines, one at 1.91 Å and another at 23.28 Å, arise from Kα-type x-ray transitions in ionized iron and oxygen, respectively. The above interpretation is confirmed by means of preliminary laboratory data and theoretical calculations and additional identifications of the same type are suggested. The significance of the discovery of this type of transition in the solar atmosphere is that it rather clearly demonstrates the presence of high-energy nonthermal particles required to produce such lines. (W.D.M.)

34993 ABUNDANCE OF LEAD IN THE SUN. Grevesse, Nicolas (Institut d'Astrophysique, Cointe-Sclessin, Belg.). Astrophys. J., 149: L37(July 1967).

The equivalent widths of the Pb lines λλ 3639.580, 3683.480, 3739.944, and 4057.813 Å were remeasured. The lead abundance was recomputed using these measurements, new transition probabilities, and a new model of the solar photosphere. The weighted mean of the abundances derived from the three lines λλ 3639, 3683, and 4057 Å is, in the log N_H = 12.00 scale, log N_{Pb} = 2.00. (W.D.M.)

34994 LOCAL CONDENSATION IN THE UNIVERSE AND SPATIAL INHOMOGENEITY OF COSMIC BLACK-BODY RADIATION. Sato, Humitaka (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 37: 1032-4(May 1967).

The possibility is suggested of finding the local condensation in the early stage of the Universe from the observation of the nonuniform distribution of the cosmic black-body radiation. (W.D.M.)

34995 NONLINEAR THEORY OF GRAVITATIONAL INSTABILITY IN THE EXPANDING UNIVERSE. Tomita, Kenji (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 37: 831-46(May 1967).

The gravitational instability in the expanding universe was studied in the second-order approximation. This work is an extension of Lifshitz's linearized theory on the basis of general relativity. Basic equations are formulated generally, but their analysis is confined to a special case where pressure effects are negligible and the spatial curvature of the unperturbed model universe is zero. The results show that the second-order density contrast tends to accentuate the increase of the first-order density contrast with time, unless the linear dimension of the perturbation is too great. Moreover it is shown that a gravitational wave is induced by deformed density perturbations even if the first-order metric perturbation includes no part of the gravitational wave. If time is reversed, the results will be applicable to the problem of the gravitational instability in a contracting universe or in a collapsing star. (auth)

34996 EXPERIMENT TO CHECK A HYPOTHESIS ON THE ANTIMATTER NATURE OF METEOR STREAMS. Konstantinov, B. P.; Bredov, M. M.; Belyaevskii, A. I.; Sokolov, I. A.; Gur'yan, Yu. A.; Pakhomov, L. P.; Bocharkin, V. K.; Alekseev, L. F.; Orlov, N. I.; Chesnokov, V. I. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 37: 743-55(Apr. 1967). (In Russian).

The general experimental setup and individual equipment and techniques employed in an experiment to check a hypothesis on the antimatter nature of meteor streams are described. In choosing the best means to register meteor phenomena, preference was given to radar over other visual and photographic techniques because of its ability to fix exactly the moments of meteor appearance and to operate under any conditions if a proper wavelength is used. A radar operating at $\lambda \approx 4$m was employed. By knowing the characteristics of the radar antenna system, it was possible to predict to within 30 minutes the time at which the registration of meteor showers would commence. Radiation measurements were carried out at altitudes of 12 to 18 km by gamma detectors aboard aircraft. Such a gamma-detector is based on a large NaI(Tl) crystal placed under the hood of a plastic scintillator. A lead converter measuring one radiation length in thickness was placed between the plastic scintillator and crystal. The crystal was optically coupled from below to four FEU-13 type photomultipliers driving a common load. The detector was hermetically sealed in a jacket to permit operation in a rarefied atmosphere. The electronic section of the detector incorporated two amplifiers, two signal shapers, and anti-coincidence and output stage circuits. Pulses corresponding to gamma quanta with an energy exceeding a threshold of 100 to 150 MeV were recorded and telemetered. Six detectors with NaI(Tl) crystals measuring 100 × 60 mm (thickness, 2.5 radiation lengths) and 100 × 100 mm (thickness, ~4 radiation lengths) were used in the experiments. The geometry of the instruments made it possible to record gamma quanta within an aperture angle >90°. Two gamma detectors were carried each time by the aircraft. On several occasions, one of the detectors was replaced by a neutron detector consisting of an SNMO-5 boron counter with a plastic moderator 6 cm thick. Two telemetry channels were employed for data transmission. Identical receivers and ultra-short-wave aircraft transmitters, adapted for operation under conditions of pulsed modulation, were used on both channels. The received data were recorded on film and on magnetic tape. A general conclusion is reached that the results obtained thus far should be considered only as experimental evidence supporting the hypothesis of the anti-matter origin of comets and meteor streams. The low altitudes at which the antimeteors burned up and the fact that $\sim 10^5$ light quanta were emitted for each gamma quantum radiated during the meteor burnup were difficult to explain. (ATD)

34997 SOLAR OBSERVATIONS AT A WAVELENGTH OF 8.6 MILLIMETERS. Kalaghan, P. M. (Air Force Cambridge Research Lab., Bedford, Mass.). pp 140-1 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2-4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

A new program extending current observations to the millimeter portion of the spectrum has been initiated at AFCRL in order to determine the utility of such short-wavelength observations for forecasting solar proton showers. This new program is discussed briefly. The observation of a flare on April 12, 1966 is reported in some detail. (W.D.M.)

34998 SOLAR OBSERVATIONS AT MILLIMETER WAVELENGTHS. Sullivan III, W. T. (Naval Research Lab., Washington, D. C.). pp 142-3 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2-4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

1-cm-drift scan data are correlated with other radio data for a solar flare event and some of the characteristics of the flare are revealed. Measurements of solar brightness temperatures for the quiet sun from 1 to 2 cm are reported. (W.D.M.)

34999 POLARIZATION OF COSMIC RADIO SOURCES. Mayer, C. H. (Naval Research Lab., Washington, D. C.). pp 144-5 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2-4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

It can be seen that recent investigations of radio sources using advanced techniques which yield the polarization parameters of the radiation, rather than the intensity corresponding to an arbitrarily chosen antenna polarization, provide a wealth of important new information about the structure and radiation mechanism of the sources themselves as well as important new information about the physical properties of the Galaxy. It should not be overlooked that they also give, for the first time, the true intensities, brightness distributions, and spectra of the sources. (W.D.M.)

35000 EVOLUTION OF MEDIUM MASS STARS. Hallgren, Elisabeth Lynn. Toronto, Univ. of Toronto, 1966.

Thesis.

The evolutionary tracks of six stars, in the medium mass range, were computed. The masses of the stars were 1.0, 1.2, 1.4, 1.7, 2.0, and 2.5 solar masses. The initial composition chosen was X = .67, Y = .30, and Z = .03, with a mixing length l/H = 1.0. The Henyey method was used to integrate the stellar models; the differential equations of stellar structure are replaced by difference equations which are solved by an iterative procedure which is a modification of Newton's method for solving nonlinear equations. Energy generation by both the carbon-nitrogen cycle and the proton-proton chain was taken into account. The opacity included radiation and conduction opacity, and the equation of state included the effects of partial degeneracy of electrons and radiation pressure. The evolution of the stars was followed from their main sequence state up to the point where their helium cores contained 10% of their total mass. During this period, the stars passed through four stages: the hydrogen-burning stage, the first gravitational contraction, the shell-burning stage, and the second gravitational contraction. During the first stage, all of the stars increased in their radii and luminosities and moved upwards and to the right in the Hertzsprung-Russell diagram. When the central value of the hydrogen content fell to .05, all of the stars, except the 1.0 $M_{\odot}$ star, could no longer maintain their energy balance and underwent gravitational contraction. While the 1.0 $M_{\odot}$ star continued to move upward in the H-R diagram, the other stars moved to the left and upward due to their decrease in radius and increase in luminosity. When all of the central hydrogen was depleted, the hydrogen in a shell around the core supplied the energy of the star. During this shell burning stage, the luminosities and radii of the stars increased, so that the stars again moved upward and to the right in the H-R diagram. The inner regions of the stars were contracting throughout these stages, as the hydrogen in the shell became depleted, this contraction was accelerated. As the shell expanded, the opacity increased, and the total luminosity dropped, so that the stars moved downward and to the right in the H-R diagram. This was a very rapid phase during which the more massive stars crossed the Hertzsprung gap. The helium cores of the stars had been growing in mass since the end of the hydrogen burning stage; the evolution was stopped arbitrarily when the helium core contained 10% of the total mass of the star. An age of 4.25×10^9 years was derived for the galactic cluster M67 using isochrones drawn from the evolutionary tracks. (Disser. Abstr.)

Atomic and Molecular Physics

35001 (AD-639311) THE SECOND PHASE OF RESEARCH ON ATOMIC STRUCTURES. Final Report. Meyers; D. F.; O'Brien, F. (C-E-I-R Ltd., London (England)). June 1966. Contract AF33(615)-2675. 73p. CFSTI.

A brief summary is made of the progress toward writing programs for solving the relativistic Hartree-Fock equations and the Hartree-Fock equations with configuration interaction. The possibility of predicting a polarization function for any isoelectronic sequence is discussed with particular reference to the Na I-Ar VIII sequence. Transition integrals for this sequence are presented. Results of an investigation on the form of the polarization function for the case of two electrons outside of closed shells are given. Modifications of a Hartree-Fock program written under a previous contract (see AD-617 705) are described and their Fortran listings are included. (auth)

35002 (CEA-R-3233) DEPLACEMENTS ET INTENSITES DES COMPOSANTES DES RAIES HYDROGENOIEDES DE L'ATOME D'HELIUM EN PRESENCE DE CHAMPS EXTERIEURS ELECTRIQUE ET MAGNETIQUE UNIFORMES. (Displacements and Intensities of the Components of Hydrogenic Lines of the Helium Atom in the Presence of Exterior Uniform Electrical and Magnetic Fields). Deutsch, Claude; Herman, Louis; Nguyen, Hoe; Drawin, Hans-Werner (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). May 1967. 64p. (In French). (EUR-3508.f). Dep.

The Waller-Foster method for hydrogenic lines of neutral helium is extended in order to take into account an external magnetic field having an arbitrary angle with an external constant electric field. The diagonal correction has been evaluated numerically taking into account recent experimental data. A Fortran IV program written for the CDC 3600 computer allows one to calculate the displacements and the intensities for any hydrogenic transition. Special attention is given to the {2-4} transitions in neutral helium. (auth)

35003 (COO-1112-112) A HIGH-RESOLUTION MEASUREMENT OF THE HYPERFINE STRUCTURE OF THE J = 1 ROTATIONAL STATE OF $^{133}Cs-^{19}F$ BY THE MOLECULAR-BEAM ELECTRIC-RESONANCE METHOD. English, Thomas Crandall (Michigan Univ., Ann Arbor). 1966. Contract AT(11-1)-1112. 278p. Dep. CFSTI.

Thesis.

The measurement and analysis of the radio-frequency spectrum of cesium fluoride, and the design, construction, and operational characteristics of the high-resolution, very-weak-field molecular-beam electric-resonance spectrometer with which this measurement was made are reported. This measurement is part of a long range program to study electric and magnetic hyperfine interactions in polar diatomic molecules. (M.O.W.)

35004 (COO-1112-117) A MEASUREMENT OF THE FINE AND HYPERFINE STRUCTURES OF THE 2^2P STATES OF ^7Li. Di Lavore III, Philip (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 98p. Dep. CFSTI.

Thesis.

An experimental determination is reported of the fine and hyperfine structures of the 2^2P term of ^7Li. The technique used for the measurements was that of level-crossing spectroscopy, wherein one takes advantage of the change of the angular distribution of the resonance fluorescence of atoms in a magnetic field which occurs when that field is such that two excited state Zeeman sublevels cross. (M.O.W.)

35005 (COO-1112-120) VELOCITY DISTRIBUTION OF METASTABLE H ATOMS PRODUCED BY DISSOCIATIVE EXCITATION OF H_2. Leventhal, M.; Robiscoe, R. T.; Lea, K. R. (Yale Univ., New Haven, Conn. Dept. of Physics). [1967]. Contract AT(11-1)-1112. 37p. Dep. CFSTI.

The velocity spectrum of metastable H(2S) atoms produced by electron bombardment of H_2 has been measured by a time-of-flight technique. Two distinct groups of metastables have been detected. The slower atoms are interpreted as arising from transitions to attractive states just above the H(1S) + H(2S) dissociation limit. The faster atoms are thought to arise from transitions to doubly excited repulsive states not previously detected. The same technique was used to obtain similar data for deuterium. (auth)

35006 (IPP-1/62) ELECTRON IMPACT IONIZATION CROSS-SECTIONS AND IONIZATION RATE COEFFICIENTS FOR ATOMS AND IONS FROM HYDROGEN TO CALCIUM. Lotz, Wolfgang (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). May 1967. 61p. Dep.

Using the empirical formula recently proposed, electron impact ionization cross sections for single ionization from the ground state are given for free atoms and for all ionization stages from hydrogen to calcium (Z = 20). For these species ionization rate coefficients are given under the assumption of a Maxwellian distribution of the impacting electrons. Lowering of ionization potential, collision limit, or multiple ionization is not taken into account. (auth)

35007 (LA-3689) COMPTON SCATTERING FACTORS FOR SPHERICALLY SYMMETRIC FREE ATOMS. Cromer, Don T.; Mann, Joseph B. (Los Alamos Scientific Lab., N. Mex.). May 3, 1967. Contract W-7405-eng-36. 116p. Dep. CFSTI.

Incoherent scattering factors for all spherically symmetric free atoms were computed from numerical SCF Hartree-Fock wave functions. The complete Waller-Hartree theory with all exchange terms was used. In addition to the incoherent scattering factors, all the matrix elements used in the Waller-Hartree expression are tabulated. (auth)

35008 (N-67-17774) THEORETICAL PHOTODETACHMENT CROSS SECTION FOR THE NEGATIVE ATOMIC OXYGEN ION. Jackson, H. J. Jr.; Garrett, W. R. (Alabama Univ., Hunts-

ville. Research Inst.). Dec. 1965. 61p. (NASA-CR-69846; UARI-32). CFSTI.

The theoretical photodetachment cross section for the negative atomic oxygen ion in its normal ground state has been investigated for the three transitions and in the photon energy range up to 12 eV. In addition, the scattering cross section for the neutral oxygen atom, the polarizability, the attachment cross section, and the attachment coefficient have also been determined. Results are compared with available experimental and other theoretical data. Excellent agreement has been obtained with the latest reliable experimental data. The Hartree–Fock treatment utilizing a modified form of the Slater approximation for exchange was used to compute the bound state radial functions for the neutral atom and negative ion. The polarization potential was developed from first-order perturbation theory in conjunction with the adiabatic approximation. The continuum wave functions for the outgoing electron were derived from Schrödinger's equation utilizing the modified Hartree–Fock–Slater and polarization potentials. The agreement of the photodetachment and neutral atomic oxygen cross sections with experimental data as well as the agreement of the polarizability calculation with experiment is a most favorable indication for the validity of this work. (auth) (STAR)

35009 (N-67-17775) CONFIGURATION INTERACTION IN THE HELIUM CONTINUUM. Altick, P. L.; Moore, E. Neal (Nevada Univ., Reno). [1965]. 32p. (NASA-CR-71233). CFSTI.

Configuration interaction is applied to the 1P helium continuum between the first and second quantum thresholds. Discrete configurations are included, which give rise to autoionization levels (resonances). Differential oscillator strengths are presented for the nonresonant region, while positions, widths, and q values are given for the six lowest lying resonance levels. (auth) (STAR)

35010 (N-67-17778) THEORY OF ATOMIC COLLISIONS. Kouri, Donald (Wisconsin Univ., Madison. Theoretical Chemistry Inst.). July 30, 1965. 240p. (NASA-CR-69990; WIS-TCI-112). CFSTI.

The separation of the rotational degrees of freedom from the N-particle Schrödinger equation is discussed and applied to the system $H^+ - H$. A symmetric definition of the Euler angles is employed, thus facilitating the inclusion of the effects of the Pauli principle due to the identity of the protons. The solutions of the coupled partial differential equations obtained are expanded in terms of Born–Oppenhiemer H_2^+ electronic wave functions and the resulting coupled equations investigated. A selection rule restricting the coupling to states of a single symmetry is derived and the asymptotic behavior of the coupled differential equations considered. Next a truncation scheme for treating the coupled equations is presented. (auth)

35011 (N-67-18195) THE SCATTERING OF ELECTRONS BY ATOMIC SYSTEMS WITH CONFIGURATIONS $2p^q$ AND $3p^q$. Smith, Kenneth; Henry, R. J. W.; Burke, P. G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). [1965]. 28p. (NASA-TM-X-57271; TP-213). CFSTI.

The theory is developed describing transitions induced by electron impact between all the ground state terms of atoms and ions with configurations $2p^q$ and $3p^q$. Full account is taken of exchange, and the computed cross sections satisfy exactly the required unitarity bounds. A description is given of the method used for the solution of the resultant coupled integro-differential equations. (auth) (STAR)

35012 (NASA-TN-D-4063) ANGULAR DISTRIBUTION OF THICK-TARGET BREMSSTRAHLUNG WHICH INCLUDES MULTIPLE ELECTRON SCATTERINGS. Scott, W. Wayne (National Aeronautics and Space Administration, Langley Station, Va. Langley Research Center). Aug. 1967. 33p.

A theoretical analysis which includes multiple electron scattering as described by a random-walk procedure is presented for predicting the spectrum of bremsstrahlung produced at angles relative to a monoenergetic flux of electrons of normal incidence on thick targets. The assumption is made that the spectral and angular distribution of radiation leaving a thick target can be considered to be the sum of the contributions from a series of thin strips, one behind the other, bombarded by electrons of continuously decreasing energy. The following processes are considered in the analysis: (1) radiation of electrons in thin targets as predicted by the Bethe–Heitler theory; (2) electron penetration into the target which includes (a) multiple electron scattering as predicted by Goudsmit–Saunderson theory, (b) electron backscatter out of the target, (c) electron energy loss in the target, and (d) electron–electron bremsstrahlung; and (3) the absorption and buildup of photons in the target. Comparisons are made between the calculated results and experimental data for aluminum and iron thick targets. On the whole the agreement is reasonably good. (auth)

35013 (NP-16781, 1-8) LOW ENERGY PHYSICS. (University Coll., London (England). Dept. of Physics).

Research on the following topics is outlined: Proton-atomic hydrogen collisions at impact energies above 40 keV, small angle scattering in charge transfer collisions, neutralization of fast Ne^+, Ar^+ and Kr^+ ions during passage through gaseous targets, excitation in 40 to 450 keV ion-atom collisions, mass spectrometric analysis of the slow ion products of ion-atom collisons. Pseudo-crossing of potential energy curves in inelastic heavy particle collisions, sequential mass spctrometry, ion-atom interchange studies of ions drifting in a gas, ion-atom interchange studies in afterflows, electron spectroscopy, energy losses in excess of 50 eV of electrons scattered by atoms, microwave cavity studies of time-dependent afterflow, excitation of He 2^1S by two photons from red ruby laser, microwave studies of dielectric relaxation, plasma in liquids. (UK)

35014 (UCRL-17587) POLARIZATION CORRELATION OF PHOTONS EMITTED IN AN ATOMIC CASCADE. Kocher, Carl Alvin (California Univ., Berkeley. Lawrence Radiation Lab.). May 1967. Contract W-7405-eng-48. 82p. Dep. CFSTI. Thesis.

Observations of the correlation in linear polarization of two photons emitted successively in an atomic cascade are described. Calcium atoms in an atomic beam are excited optically ($4^1S_0 \rightarrow 6^1P_1$) by ultraviolet continuum radiation from a high-intensity low-voltage H_2 arc lamp. Photon pairs emitted in the cascade $6^1S_0 \rightarrow 4^1P_1 \rightarrow 4^1S_0$ (5513Å and 4227Å) are detected by conventional photomultipliers fitted with rotatable linear polarizers of the Polaroid type. The coincidence counting rate, recorded by a time-to-height converter and multichannel pulse-height analyzer, is found to be consistent with the theoretical correlation $(\hat{\epsilon}_1 \cdot \hat{\epsilon}_2)^2$, where $\hat{\epsilon}_1$ and $\hat{\epsilon}_2$ denote the observed linear polarizations. (auth)

35015 (ORNL-tr-1711) EXCITATION OF INERT GASES IN ELECTRON-ATOMIC COLLISIONS. II. NEON. Feltsan, P. V.; Zapesochny, I. P.; Pouch, M. M. Translated for Oak Ridge National Lab., Tenn., from Ukr. Fiz. Zh., 11: 1222-30(1966). 13p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The results are presented of a detailed study of the excitation cross sections of 27 lines of the 30 available as upper levels with an electron configuration of $(1s^2\ 2s^2\ 2p^5)$ 3p (the 2p level in Pachin's notation), and of the intensive lines for which these ten 2p levels are finite. The measurements were taken over a spectral range of 3400–9700 Å in the electron energy region from excitation potentials up to 150 eV and on observing the optimal neon pressure conditions, density and energetic homogeneity of the electron beam. The results are compared with the data on the excitation cross sections of some lines and levels previously obtained by other authors. (auth)

35016 SPALLATION FORMULA DEDUCED FROM CASCADE AND EVAPORATION THEORIES COMPARED WITH EXPERIMENTS. Schwarz, U.; Oeschger, H. (Univ. of Bern). Z. Naturforsch., 22a: 972-4(June 1967).

A semiempirical formula $\sigma(\Delta A, E_0, A_0)$, giving the sum of the spallation cross sections of the products of an isobar as a function of the mass loss ΔA, the primary energy E_0 of the irradiating particle and the atomic mass number A_0 of the target nucleus is deduced. The formula is intended to be used for the interpretation of the spallation product distribution in meteorites, in the atmosphere of the earth and hopefully in cosmic dust and lunar surface samples. (auth)

35017 INTENSITY OF BREMSSTRAHLUNG AND CHARACTERISTIC K X RAYS FROM THIN ANODES. Fischer, B.; Hoffmann, K.-W. (Technische Hochschule, Stuttgart). Z. Phys., 204: 122-8(1967). (In German).

The intensities of bremsstrahlung and characteristic K x rays of thin Al, Mn, Cu, Se, Ag, and Sn targets were measured with a scintillation counter. The angle between the 50-keV electrons and the direction of emission was 90°. The spectral intensity of bremsstrahlung for 20-keV quantum energy was determined in agreement with the theory of Kirkpatrick and Wiedmann. The result obtained is $i_\nu = (2.7) \times 10^{-33} \cdot Z^{1.0}$ ergs per steradian, unit frequency interval, bombarding electron and atom-per-cm^2. The cross section of K ionization by electron impact was found by measuring the characteristic K x-ray intensity in agreement with known theoretical and experimental values. The result of this work is $\sigma_K = (7.0) \times 10^{-16} \cdot Z^{-4.3}$ cm^2. (auth)

35018 ATTACHMENT COEFFICIENTS AND DRIFT VELOCITIES FOR ELECTRONS IN AIR. Hessenauer, H. (Univ., Hamburg). Z. Phys., 204: 142-54(1967). (In German).

Electron drift velocities and attachment coefficients were measured in dry air (E/p = 0.1 to 30 V/cm torr) and in a 9:1 nitrogen/oxygen mixture (E/p = 0.2 to 3 V/cm torr) in the pressure range from 50 to 200 torr, using a modified spark chamber technique.

The primary electrons were released by an α particle. The temporal development of the electron density in the gap was determined from the amplitude of the current due to the avalanches, which were produced by applying high-voltage pulses at different delay times. It was found that in air the dissociative attachment sets in at higher E/p (~10 to 15 V/cm torr) than in oxygen. At lower E/p three-body attachment is predominant. When the high-voltage pulses were applied after the transit time of the primary electrons, electron avalanches still appeared. It was concluded that they were started by electrons which were detached from negative ions. The estimated detachment rates indicate the formation of O_2^- ions at low E/p and of O^- ions at higher E/p. (auth)

35019 PICKUP, IONIZATION, AND IONIZATION WITH PICKUP PROCESSES IN COLLISIONS OF PROTONS WITH ARGON ATOMS. Afrosimov, V. V.; Mamaev, Yu. A.; Panov, M. N.; Uroshevich, V. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 37: 717-25(Apr. 1967). (In Russian).

An experimental technique, in which coincidences are recorded between scattered and recoil particles of given charges, was employed to determine the relative cross sections for different elementary processes in the collision of 5 to 50 keV protons with argon atoms, and the absolute cross sections for the elementary processes were calculated from the measured relative cross sections and data in the literature on the absolute cross sections for different combined processes. In the author's notation, pqrs denotes the process $P^{p+} + T^{q+} \rightarrow P^{r+} + T^{s+} + (r + s - p - q)e^-$, where P is the projectile and T is the target particle. The absolute cross sections for the 1001, 1002, 1003, 1011, 1012, 1013, $10\bar{1}2$, and $10\bar{1}3$ processes were evaluated, are presented graphically, and are discussed. The contribution of the 1001 process to the production of Ar^+ ions is predominant at low energies, but the cross section for this process decreases with increasing incident proton energy whereas that for the 1011 process increases and the two cross sections become equal at a proton energy of about 47 keV. The 1002, 1012, and $10\bar{1}2$ processes contribute to the production of Ar^{2+} ions, the cross sections decreasing in the order in which the processes are mentioned above. The contribution of the 1003 process to the production of Ar^{3+} ions is about twice that of the 1013 process over most of the investigated range of proton energies, but the contributions of the two processes differ by only about 25% at the high energy end of the range. The $10\bar{1}3$ process also contributes, but its cross section is very small. (ATD)

35020 ENERGY SPECTRUM OF ELECTRONS EMITTED FROM MOLYBDENUM AFTER BOMBARDMENT WITH HELIUM AND ARGON ATOMS OR IONS. Arifov, U. A.; Dzhurakulov, Kh.; Rakhimov, R. R. (Physical-Technical Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 33-9(1966). (In Russian).

A Mo foil 13 × 7 × 0.02 mm was degassed by thermal treatment at temperatures of 2000 and 2300°K for periods of 30 and 5 hr respectively in a vacuum of 1 to 2×10^{-7} mm Hg std. The energy distribution of the secondary electrons was measured 3 to 4 sec after a brief "flare" at a temperature of 2300°K. The work function ϕ was determined by Richardson's method. The thermoelectron current was measured on a Faraday cylinder on the opposite side of the bombarded surface at 30 mm from the target. Target temperature was measured by comparing the target brightness with the brightness of a Mo wire. The initial value of the work function of the Mo foil was 6 to 7 eV, which fell to a value of 4.29 eV after the thermal treatment. The electron kinetic energy ϵ_k is plotted as a function of the percent of secondary electrons having energies between ϵ_k and $\epsilon_k + d\epsilon_k$ at 1.5, 3, and 5 keV bombardment energies of He and Ar ions or atoms. At a given energy of the bombarding particle, the electron energy spectrum was harder in the case of He than in the Ar case. With increasing kinetic energy of the bombarding atoms, the emission increased as a result of the production of 0 to 10 eV electrons for He, and 0 to 7 eV electrons for Ar. The higher energy electrons were about 15% of the total. The position of the distribution maxima was shifted to higher energies of 2 to 3 eV for He and 1.5 to 2 eV for Ar. On increasing the kinetic energy of the bombarding atoms from 1.5 to 5 keV, the average kinetic energy of the secondary electrons increased from 3.6 to 5.5 eV for He, and from 2.75 to 3.5 eV for Ar. (TTT)

35021 TRANSITION RADIATION OF A PERIODICALLY MOVING CHARGE. Barsukov, K. A.; Kalikinskaya, M. P. (Moscow State Pedagogical Inst.). Zh. Tekh. Fiz., 37: 602-6 (Apr. 1967). (In Russian).

The electromagnetic radiation of a point charge moving on the z axis of a rectangular Cartesian coordinate system x-y-z in accordance with the equation of motion $z = a \sin Ft$, where t is the time and a and F are constants, is calculated for the case when the x-y plane is perfectly conducting. Expressions were derived for the energy and angular distribution of the radiation in the different harmonics and for the field strengths in the wave zone. The field in the wave zone was polarized with the electric vector perpendicular to the plane through the z axis. The presence of the conducting sheet did not affect the energy radiated in the odd harmonics, but it considerably increased the energy radiated in the even ones. For a velocity amplitude of $aF = 0.8c$ (c is the velocity of light), the presence of the conducting sheet increased the energy in the second and fourth harmonics by 30 to 40 times. This effect may find application in the design of microwave frequency multipliers. (ATD)

35022 SOME ASPECTS OF FOCUSING OF ION BEAMS BY LINEAR STATIC FIELDS. Sivkov, Yu. P. Zh. Tekh. Fiz., 37: 659-65(Apr. 1967). (In Russian).

Certain general features of first-order electron optics are discussed. The equations of the trajectories are written in a Hamiltonian form in which the independent variable is the distance s measured along a selected standard trajectory, the two coordinates representing a trajectory at given value of s are the projections in two mutually perpendicular directions of the segment joining the trajectory to the standard trajectory, and the momenta conjugate to these coordinates are proportional to the slopes of the projections of the trajectory onto the corresponding mutually perpendicular planes tangent to the standard trajectory. The first-order changes with s in the coordinates and momenta of a trajectory are therefore given by a simplectic transformation. The problem of injecting ions into an accelerator is regarded as that of transforming by means of a simplectic transformation the four-dimensional ellipsoid in phase space that represents the available beam into the four-dimensional acceptance ellipsoid of the accelerator. A complete set of invariants of the simplectic group are found, and with the aid of these the ellipsoids in the four-dimensional phase space are so classified into two classes that any ellipsoid of either class can be transformed into any other ellipsoid of the same class. (ATD)

35023 SPACE CHARGE WAVES IN A DENSE DRIFTING ELECTRON STREAM WITH A MONOTONICALLY VARYING CROSS SECTION. Kulakov, A. V. (Leningrad Polytechnic Inst.). Zh. Tekh. Fiz., 37: 650-8(Apr. 1967). (In Russian).

The propagation of space charge waves in a dense electron beam with monotonically varying cross section and velocity is discussed. The electrons are assumed to move in an axially symmetric drift tube on the walls of which there is somehow maintained an assigned potential distribution. Collisions among the electrons are neglected and it is assumed that the electrons do not interact with any external fields such as might be produced by the system that maintains the longitudinal potential distribution on the wall of the drift tube. The problem is reduced to a one-dimensional problem with the aid of the following assumptions: everything is independent of the azimuth the current density and the axial component of the electron velocity is independent of the distance from the axis, the radial component of the velocity of each electron is proportional to its distance from the axis, and the radial component of the electron velocity is small compared with the axial component. A linear wave equation is derived for the space charge waves on the assumption that the amplitude of the waves is small and its steady state solution is discussed in the form of a transfer matrix giving the alternating components of the current and electron velocity at one point in terms of their value at another point. The elements of the transfer matrix are calculated for the case of a converging beam of constant velocity electrons. This solution reduces for the case of a cylindrical beam to a previously known result. It is found that the space charge waves damp out as they propagate along a converging beam and increase in amplitude as they propagate along a diverging beam. The presented equations should be useful for the investigation of electron beams having a periodic structure and for calculating the noise associated with electron beams. (ATD)

35024 ACHROMATIC HELICAL QUADRUPOLE SYSTEM. Strashkevich, A. M.; Trotsyuk, N. I. Zh. Tekh. Fiz., 37: 645-9 (Apr. 1967). (In Russian).

The condition for vanishing of the first-order chromatic aberration of a combined electrostatic-magnetostatic helical quadrupole lens is derived. The intersections of the electrodes and the surfaces of the pole pieces of the considered lenses with planes perpendicular to the axis are 90° arcs of concentric circles, the pole pieces are displaced from the electrodes in azimuth by 45°, and both the electrodes and the pole pieces form helices of the same pitch. The calculations are based on relativistic trajectory equations, and the possibility of achieving achromaticity with a finite focal length appears to depend on the presence of the relativistic variation of mass with velocity. (ATD)

35025 THEORY OF FOCUSING OF QUASI-NEUTRAL BEAMS BY AXIALLY SYMMETRIC ELECTROMAGNETIC FIELDS. Morozov, A. I.; Lebedev, S. V. Zh. Tekh. Fiz., 37: 633-44(Apr. 1967). (In Russian).

The focusing of quasineutral beams by a certain class of axially symmetric static electromagnetic fields is discussed in detail with the aid of the method of G. A. Grinberg. In the considered fields the electric and magnetic lines of force lie in the r-z planes of a cylindrical coordinate system and the electron drift trajectories are closed. The geometry of the fundamental trajectory is discussed in detail, only those fields being considered for which the fundamental trajectory satisfies certain conditions, and the first order aberrations are calculated. (ATD)

35026 NUMERICAL, THEORETICAL, AND EXPERIMENTAL INVESTIGATIONS ON A HIGH-CURRENT TELEFOCUS ELECTRON GUN OF THE TETRODE TYPE. Bas, E. B.; Cremosnik, G.; Thomas, R. N.; Wiedmer, H. B. (Eidgenoessische Technische Hochschule, Zurich). Z. Angew. Math. Phys., 18: 379-96 (May 25, 1967). (In German).

Starting from an earlier investigation of a telefocus-electron gun of the triode-type, a telefocus-gun of the tetrode-type for high beam currents was theoretically and experimentally investigated and the main results are presented. In the first part of this work a model-system has been investigated by numerical-theoretical methods to get an idea of the electron paths inside the gun as well as to estimate the highest obtainable perveance of the gun. In these investigations an analogy-resistance-network for the plotting of potential fields and an electronic computer for the electron path calculations have been used. These calculations showed that an electron-gun of small geometrical dimensions can be built which is able to focus high beam currents at long distances from the cathode. The relevant gun parameters are a short distance from cathode to first-anode and a high negative Wehnelt-potential. In the second part of the paper the results of some experimental investigations are reported. The experiments showed that by suitable dimensioning a 50 mA, 20 kV electron beam can be focussed in a crossover of some few tenths of mm diameter at a distance of 150–250 mm from the cathode. Some examples for the gun data are given. The aberrations of the electron gun are considerable at the higher currents. At 20 kV one can easily obtain a beam current of 150 mA with a cathode of 2 mm diameter. The aberrations influence infavourably the current density distribution in the crossover. The disturbance is especially noticeable for long cathode to focus distances as was the case in some reported experiments with a cathode to focus distance of 410 mm. The described telefocus-gun has been used for electron beam welding and some practical conclusions of these experiments are discussed. (auth)

35027 CHERENKOV RADIATION BY LINE CHARGE. Khan, R. M. (City Coll., Calcutta). Indian J. Phys., 41: 226-9(Mar. 1967).

Radiation which is produced by a line charge rather than a point charge or a beam of electrons is investigated. The line charge consists of a continuous line density moving with a constant velocity perpendicular to the line within a dielectric medium. The medium is assumed to be a perfect dielectric and the absorption of radiation, dispersion, and scattering are ignored. The medium is unbounded, so the sweeping plane is infinite. (M.O.W.)

35028 CHERENKOV RADIATION IN A MEDIUM OF VARIABLE DIELECTRIC CONSTANT. Khan, R. M. (City Coll., Calcutta). Indian J. Phys., 41: 171-5(Mar. 1967).

Cherenkov effect in a medium with a variable dielectric constant alters the amplitude of each component of the field variable and the output of radiation compared to the usual Cherenkov radiation as obtained by Frank and Tamn (1937). Even if asymptotically the specific inductive capacity becomes a constant, the radiation still then remains different. Semi-vertical angle of the cone of radiation fluctuates with the change of dielectric constant. (auth)

35029 ELASTIC SCATTERING OF ELECTRONS BY HYDROGEN ATOM. Gupta, S. B.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). Indian J. Phys., 41: 163-70(Mar. 1967).

The total cross sections of elastic scattering of electrons by hydrogen atoms at the incident energies of 13.6, 54.4, 122.4, and 217.6 eV have been calculated in the Born-Oppenheimer approximation with the neglect of the core interaction term and taking into account the distortion of the plane incident wave in the field of the target atom. (auth)

35030 NEGATIVE-ION SPALLATION OF SOLID SURFACES UNDER ION BOMBARDMENT. Ayukhanov, A. Kh.; Abdullaeva, M. K. Izv. Akad. Nauk SSSR, Ser. Fiz., 30: 2000-7(Dec. 1966). (In Russian).

Results of mass-spectrometric studies of the composition of negative ion spallation products (aluminum, copper–beryllium, silicon, copper, zirconium, and titanium) under bombardment of cesium ions and comparative studies of mass spectra of negative ions during Ti target bombardment by Cs^+ and Na^+ ions are discussed. (R.V.J.)

35031 DETERMINATION OF ABSOLUTE AVERAGE ENERGY FOR ION PAIRS IN GASES. Buektas, Umur (Technische Hochschule, Munich). Z. Angew. Phys., 23: 74-7(1967). (In German).

The absolute average ionization energy W, necessary to form an ion pair in air, O_2, N_2, CO_2, and Ar was determined for T beta particles. In order to do this the maximal ion current produced by the T source was measured for each gas and also calculated from the known shape of the energy distribution curve. The results for W_β are in excellent agreement with relative values from other authors based on W_α for alpha particles in argon. (auth)

35032 LANDAU DAMPING IN ELECTRON BEAMS. Caulton, Martin (RCA Labs., Princeton, N. J.). RCA Rev., 28: 297-316 (June 1967).

It is shown that the experimental damping rate predicted by Landau for a stationary plasma with a Maxwellian distribution of velocities is equivalent to the spatial damping rate calculated for a moving electron beam with a cut-off Maxwellian distribution of velocities. This is done by extracting the spatial damping rates and converting them to temporal equivalents, and by using a Galilean transformation and a Doppler frequency shift to show that the damping-determining factors of the moving electron beam are equivalent to the damping-determining factors for a stationary plasma, i.e., the ratio of plasma wave number to Debye wave number. The damping rates of over 50 experiments reported earlier involving the decay of space-charge waves in electron beams are then found to agree with the predictions of the electron beam theories, i.e., Landau damping. It is suggested that this constitutes a quantitative verification of Landau damping in electron beams. (auth)

35033 NEW AGE IN PHYSICS. Second Edition. Massey, Harrie. London, Elek Books Ltd., 1966. 386p. 63s.

An account is given of research in physics under the following main headings: atoms and atomic structure; atom mechanics and the uncertainty principle; electrons; relativity; relativistic quantum theory; exploring the atomic nucleus; exploitation of the nucleus; cosmic rays and strange particles; neutrinos; radioastronomy; exploring the upper atmosphere; and artificial satellites and space probes. (UK)

35034 HIGH RESOLUTION NUCLEAR MAGNETIC RESONANCE EXPERIMENTS. PART I. PRECISION MEASUREMENT OF THE NUCLEAR MAGNETIC MOMENT RATIO $\mu(^3He)/\mu(^1H)$. PART II. A FURTHER SEARCH FOR MASS ANISOTROPY. Williams, William Lee. New Haven, Yale Univ., 1966. 108p.

Thesis.

The nuclear magnetic moment ratio $\mu(^3He)/\mu(^1H) = -0.76178684$ (7) was measured in a gaseous sample at room temperature. Combined with the value of $\mu(^1H)/\mu_s$ obtained from the Lambe–Dicke measurement of $(g_j)_{^3\Sigma^+_1}/g_{^1P_1}$ this ratio gives $\mu(^3He)/\mu_s = 1.1587412 \times 10^{-3} \pm 0.3$ ppM. The uncertainty arises entirely from proton diamagnetic shielding corrections. In turn, the derived hyperfine structure (hfs) anomaly ratio is $(1-\delta_{^3He})/(1-\delta_p) = 1-(183.6 \pm 0.4)$ ppM. This compares with the theoretical value $1-(140 \pm 6)$ ppM. The ^7Li nuclear magnetic resonance experiment of Hughes, Robinson and Beltran-Lopez, devised originally as an experimental check on the validity of Mach's principle, was repeated with improved resolution. The experiment was also performed at three different orientations of the dc magnetic field. A similar set of measurements was performed with ^{85}Rb to search for a different sideral variation than that predicted for ^7Li, due to the differences in the nuclear spins. Both experiments gave a null result, the most accurate limit being that obtained with ^7Li. This result is interpreted in terms of the Cocconi–Salpeter theory to give a limit, $\Delta m/m \leq 5 \times 10^{-23}$, for the fractional change in mass due to anisotropic inertial effects. Interpretation in terms of the Dicke theory puts a limit on the coupling strength of a second "strongly anisotropic" gravitational tensor field, h_{ij}, of 5×10^{-23} as compared to the coupling to the ordinary gravitational field g_{ij}. (auth) (Disser. Abstr.)

35035 MODERN PHYSICS FOR ELECTRICAL ENGINEERS. Kendall, E. J. M. London, Macdonald and Co. Ltd., 1966. 202p. 50s.

The following topics are covered: The atom and spectroscopy–Electronic structure of atoms–X rays and X-ray spectra–Crystal structure and X-ray crystallography–Elementary quantum mechanics–Free electron theory of metals–Band theory of solids–Physical principles of semiconductor devices–Isotopes and natural radioactivity–Theories of alpha, beta and gamma emission–Interaction of nuclear particles with matter–Detection of nuclear particles and photons–Sources of nuclear energy–Special theory of relativity–Radiation hazards. (UK)

35036 FOCUSING OF CHARGED PARTICLES. VOLUME II. Septier, Albert (ed.). New York, Academic Press, 1967. 481p. $19.00; 152s.

The theoretical and experimental aspects of the problems involved with focusing, directing, and obtaining high-resolution beams of charged particles are discussed. Methods for calculating and measuring electric and magnetic fields and particle trajectories are considered. (B.G.D.)

Cosmic Radiation

Refer also to abstracts 34465, 34491, and 35257.

35037 (AECL–2703) COSMIC RAY NM-64 NEUTRON MONITOR DATA. VI. Monthly Graphs, January 1967–April 1967. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1967. 85p. (CRGP–1259). Dep. CFSTI. CAN $2.00.

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada using equipment maintained by AECL are given in tabular form for the period from January to April 1967. Normalized graphs are given for the period January to April 1967. The five-minute results for the solar-particle event of January 28, 1967, and a warning about a spurious annual variation are included. (auth)

35038 (BMwF-FBK–67-38) DAS KIELER LUFTSCHAUER-EXPERIMENT. TEIL I. UEBERBLICK UEBER AUFBAU UND VORLAEUFIGE MESSERGEBNISSE. (The Extensive Air Shower Experiment at Kiel. Part I. Construction and Preliminary Results). Boehm, E.; Buescher, W. D.; Fritze, R.; (and others) (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). May 1967. 44p. (In German). Dep.

The physical background, the construction, and principal goals as well as preliminary results of the air shower experiment are reviewed. (auth)

35039 (BMwF-FBK–67-39) DAS KIELER LUFTSCHAUER-EXPERIMENT. TEIL II. DIGITALISIERUNG DER SZINTILLATIONSZAEHLERAMPLITUDEN. (The Extensive Air Shower Experiment at Kiel. Part II. Digital Recording of Scintillation Counter Pulses). Staubert R. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). May 1967. 46p. (In German). Dep.

A general survey about the logic of the recording system and the electronics of the air shower experiment at Kiel is given. In detail the measurement of particle numbers is described. The scintillation counter amplitudes are digitized using a logarithmic analog-to-digital converter with a dynamics of $1:10^4$. (auth)

35040 (BMwF-FBK–67-40) DAS KIELER LUFTSCHAUER-EXPERIMENT. TEIL III. DIE BESTIMMUNG DER EINFALLSWINKEL GROSSER LUFTSCHAUER. (The Extensive Air Shower Experiment at Kiel. Part III. Determination of Arrival Direction of EAS). Fritze, R. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). May 1967. 63p. (In German). Dep.

The fast timing equipment used for the determination of arrival directions of extensive air showers is described. The delays between two counters are measured by time-to-amplitude converters working on the overlapping principle. The resulting amplitudes are digitized and typed and punched along with the outer air shower data by a teleprinter. The resolution of timing is 1 nsec at particle densities above $10/m^2$. This leads to an error of zenith angle of $1.5°/\cos\theta$. (auth)

35041 (BMwF-FBK–67-41) DAS KIELER LUFTSCHAUER-EXPERIMENT. TEIL IV. DIE ELEKTRONISCHE DATENAUSGABE. (The Extensive Air Shower Experiment at Kiel. Part IV. Digital Data Recording System). Roose, U. J. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). May 1967. 21p. (In German). Dep.

Electronic equipment for simultaneous operation of 16 scintillation counters, a Cherenkov counter, a $32\text{-}m^2$ neon hodoscope, and a μ-meson spectrometer is described. The arrangement and functioning of the detectors is discussed and the automatic electronic recording system for preparation and readout of data by a teleprinter and on paper tape is explained. (auth)

35042 (BMwF-FBK–67-42) DAS KIELER LUFTSCHAUER-EXPERIMENT. TEIL V. DAS NEONHODOSKOP. (The Extensive Air Shower Experiment at Kiel. Part V. Neon Hodoscope). Samorski, M. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). May 1967. 65p. (In German). Dep.

A detailed description of the features and construction of a $32\text{-}m^2$ neon hodoscope is given, operating in an extensive air shower experiment at Kiel since June 1965. The hodoscope is used to examine the fine structure of air shower cores. The different forms of air shower cores so far detected are reviewed. The methods of scanning neon hodoscope pictures and of data processing are discussed in connection with the physical aims of the experiment. First preliminary results are compared with those of other air shower groups. (auth)

35043 (BMwF-FBK–67-43) DAS KIELER LUFTSCHAUER-EXPERIMENT. TEIL VI. DATENVERARBEITUNG UND VORLAEUFIGE ERGEBNISSE. (The Extensive Air Shower Experiment at Kiel. Part VI. Data Processing and Preliminary Results). Boehm, E. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). May 1967. 13p. (In German). Dep.

The processing of scintillation counter data of the air shower experiment at Kiel is described. The determination of the total particle number, core position, direction of incidence as well as steepness of the lateral distribution is obtained by a best fit method, comparing a predetermined lateral distribution function with the scintillator data. Preliminary results of the evaluations are given. (auth)

35044 (BMwF-FBK–67-44) DAS KIELER LUFTSCHAUER-EXPERIMENT. TEIL VII. UNTERSUCHUNGEN AN EINER AKUSTISCHEN FUNKENKAMMER. (The Extensive Air Shower Experiment at Kiel. Part VII. Studies on a Sonic Spark Chamber). Priesmeyer, H. G. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). May 1967. 33p. (In German). Dep.

The acoustical method to determine spark positions is tested in an air-filled spark chamber of 1 m × 1 m size. With the 1-m-long piezoelectric microphone the resolution in the spark position is ≤0.5 mm. Even for great spark distances R the output signal U_p of the microphone is well above the noise level ($U_p \sim R^{-\frac{1}{2}} \exp(-\beta R)$). Measurements on the influence of the supersonic region independence from spark voltage, spark length, and distance from spark to microphone are discussed. (auth)

35045 (BMwF-FBK–67-45) DAS KIELER LUFTSCHAUER-EXPERIMENT. TEIL VIII. NEBELKAMMERMESSUNGEN AN LUFTSCHAUERN. (The Extensive Air Shower Experiment at Kiel. Part VIII. Cloud Chamber Studies of EAS). Wolter, W. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). May 1967. 26p. (In German). Dep.

For testing the apparatus of the air shower experiment at Kiel a preliminary experiment was installed containing a small cloud chamber. The transistorized electronics for operating the cloud chamber is described. To study the stereoscopic cloud chamber photographs a simple reprojection system was used. The angular distribution of the air shower particles was analyzed. (auth)

35046 (N-67-18958) VARIATIONS OF COSMIC RAYS ACCORDING TO THE DATA OF INTERPLANETARY PROBES ZOND-3 AND VENUS-2. Vernov, S. N.; Chudakov, A. E.; Vakulov, P. V.; Logachev, Yu. I.; Lyubimov, G. P.; Pereslegina, N. V. Translated from Doki. Akad. Nauk SSSR, 171: 583-6(1966). 5p. (NASA-CR-82437). CFSTI.

The intensity variations of cosmic rays were measured by the counters of Zond-3 and Venus-2; these probes moving in different directions allow accounting for their temporal variations and determining their radial gradient. To explain the radial gradient of protons with energy 1 to 5 MeV, detected by the probes' apparatus, and of which the temporal character is ruled out, various mechanisms are proposed, which concern both the galactic and solar origin of these protons. (auth)

35047 THE RIGIDITY DEPENDENCE OF THE SOLAR MODULATION AT SOLAR MINIMUM, 1965. Hofmann, D. J. (Univ. of Minnesota, Minneapolis). Planet. Space Sci., 15: 727-32(Apr. 1967).

The spectral data on primary cosmic-ray protons and helium nuclei, presented in the previous paper, (Hofmann and Winckler, Planet. Space Sci., 15: 715-25(1967)) are analyzed with the assumption that the solar cycle modulation is due to a diffusion-convection process in which the scattering mean free path is both a function of rigidity and radial distance from the Sun. In addition to these measurements made in 1965, balloon measurements made in 1963 and 1964 at low rigidities, ion chamber measurements at intermediate rigidities, and neutron monitor intensities at high rigidities are used to investigate the rigidity dependence of the scattering mean free path near solar minimum. A function of the form $(1 + P/P_0)$, where P is the particle rigidity and P_0 is a time-varying parameter related to the scale size and magnetic field intensity of the scattering irregularities, is found to describe the modulation above 0.4 BV rigidity. The assumed radial power law form for the scattering mean free path is found to have an exponent in the range 1.00 to 1.08 from the observed time variations. (auth) (UK)

35048 AN APPARENTLY HIGH FLUX OF PRIMARY COSMIC-RAY He-NUCLEI AT 41°N MAG. Friedlander, M. W.; Klarmann, J. (Washington Univ., St. Louis). Planet. Space Sci., 15: 619-25(Apr. 1967).

The flux of primary cosmic-ray helium nuclei was measured in nuclear photographic emulsions exposed on a high-altitude balloon flight in Texas, in April 1965. The flux value derived was 110 ± 8 particles/m^2/sec ster, substantially in excess of that expected on the basis of data obtained in 1954–6, at the time of the previous minimum in solar activity. A reexamination of published records of older flights shows that the geomagnetic cutoff values assumed were in error. Discussions of solar modulation effects in the high-energy region will require modification. (auth) (UK)

35049 THE MEASUREMENT AT BALLOON HEIGHTS OF THE LOW ENERGY HYDROGEN AND HELIUM ISOTOPES IN THE COSMIC RADIATION AT SOLAR MINIMUM, 1965. Hofmann, D. J.; Winckler, J. R. (Univ. of Minnesota, Minneapolis). Planet. Space Sci., 15: 715-25(Apr. 1967).

A dE/dx-E scintillation counter device was flown at absolute solar minimum, in terms of particle influx, on 12 May, 1965, from Barrow, Alaska. Due to the resolution characteristics of the instrument, isotopic separation of hydrogen and helium nuclei in the cosmic radiation was possible. Twenty-six hours of data obtained in the atmospheric depth interval from 3.5 to 5 g/cm^2 are analyzed to determine the energy spectrum of primary galactic protons in the primary energy interval 70 to 150 MeV, an upper limit on the primary deuteron flux in the interval 45 to 60 MeV/nucleon, the spectrum of primary ^{3}He nuclei in the energy interval 90 to 150 MeV/nucleon, and the spectrum of primary ^{4}He nuclei in the energy interval 80 to 120 MeV/nucleon. The ratio of ^{3}He nuclei to total helium nuclei at the same energy/nucleon was found to be 0.11 ± 0.5 at 100 MeV/nucleon. (auth) (UK)

35050 DEPENDENCE OF COSMIC-RAY INTENSITY IN INTERPLANETARY SPACE UPON THE EARTH'S HELIO-LATITUDE. Dorman, L. I.; Luzov, A. A.; Mamrukova, V. P. (Izmiran, Moscow. Sib Izmiran, Izkutsk, USSR). J. Atmos. Terrest. Phys., 29: 471-5(Apr. 1967).

The yearly change in the intensity of the secondary components (hard and neutron) of cosmic rays is determined as a function of the Earth's helio-latitude using the data of the worldwide network of cosmic-ray stations and of the aerological sounding of the atmosphere in 1958, 1960, and 1963. The results are compared with the dependence of the magnetic activity K_p index and with the areas of flacculi fields. The gradient of the cosmic-ray intensity in the direction perpendicular to the ecliptic plane is found. The meridional structure of interplanetary space and its change with the solar cycle are determined. (auth) (UK)

35051 RADIO GALAXIES AND THE ORIGIN OF COSMIC RAYS. Schmidt, Maarten (Mount Wilson Observatory, Pasadena, Calif. Palomar Observatory, Pasadena, Calif. Carnegie Institution of Washington, D. C. California Inst. of Tech., Pasadena). Astrophys. J., 149: L39(July 1967).

The origin of cosmic rays is usually associated with supernovae or other energetic events in the Galaxy. This view has been challenged by Burbidge (1962, 1963) and Burbidge and Hoyle (1964) who claim that the bulk of the cosmic-ray energy density of around 10^{-12} ergs cm^{-3} may originate in strong extragalactic radio sources. Ginzburg and Syrovatskii (1964) reviewed the evidence and concluded that most of the cosmic rays are probably not of extragalactic origin. A new argument supporting this view is given. (W.D.M.)

35052 SHORT-PERIOD VARIATIONS OF COSMIC-RAY INTENSITY. Dhanju, M. S.; Sarabhai, V. A. (Physical Research Lab., Ahmedabad, India). Phys. Rev. Lett., 19: 252-4(July 31, 1967).

The Bolivian Air Shower Joint Experiment detector was used to establish the occurrence of time variations of galactic cosmic rays with very short periods, of the order of a few minutes. The investigation was conducted from April 1964 to June 1966, and the detector had a counting rate of a million counts per minute. (M.O.W.)

35053 ELECTROMAGNETIC CASCADE SHOWERS FROM COSMIC RAY MUONS IN DENSE MATERIAL. Hilton, Lyle Kent. Salt Lake City, Univ. of Utah, 1967. 72p.

Thesis.

Two large area water Cherenkov counters were used in conjunction with several rows of cylindrical spark counters to detect electromagnetic cascade showers from cosmic muons. The trajectory of the muon could be determined to within one degree using the localized discharges in the spark counters. Eastward and westward going shower events having 40 to 120 or more particles in water from 0 to 30° above the horizon are presented in 10° groupings. The plot of rate of showers received versus number of particles in the shower falls off faster than the theoretical curve. The region of discrepancy is for energy transfers of approximately 50 GeV and greater. (auth) (Disser. Abstr.)

Direct Energy Conversion

Refer also to abstract 34933.

35054 (CEA-Bib-85) CONVERSION D'ENERGIE EXPLOSIVE EN ENERGIE ELECTROMAGNETIQUE. (Conversion of Explosive Energy into Electromagnetic Energy). Bernard, Jean (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1967. 59p. (In French). Dep.

Thesis. Submitted to Paris Univ., Orsay, France.

The phenomenon of conversion of explosive energy into electromagnetic energy is described for devices with compression of magnetic field by explosives, devices with ferromagnetic or ferroelectric transducers, and MHD devices with explosives. The advantages of the use of such devices for very high powers of short duration are discussed. The principles, the theoretical models, and the experimental studies made on each of the three devices are summarized. (J.S.R.)

35055 (N-67-16043) TABLES OF THERMIONIC PROPERTIES OF THE ELEMENTS AND COMPOUNDS. Carr, Kenneth (Rose Polytechnic Inst., Terre Haute, Ind.). 1967. 34p. (NASA-TM-X-52263). CFSTI.

For emission physics utilization, the thermionic and electric properties of solid and liquid elements and compounds are tabulated. Data cover: absorption heat, electric dipole moments, electronic polarizability, emission properties, minimum effective work functions, selected vapor pressures, and desorption energies. An extensive bibliography is included. (STAR)

35056 (P-3583(RAND)) COMPARISON OF MHD INDUCTION GENERATOR ANALYSES. Wang, T. C. (TRW Systems, Redondo Beach, Calif.); Dudzinsky, S. J. (RAND Corp., Santa Monica, Calif.). Apr. 1967. 14p.

Three different analyses of a common model of the flat-channel, linear MHD induction generator which appear in the current literature are discussed, and an apparent discrepancy in the results of these analyses is explained. (M.O.W.)

35057 GRAPHO-ANALYTIC CALCULATION FOR AN MHD GENERATOR CHANNEL. Vulis, L. A.; Kusainov, M. K. Magn. Gidrodin., No. 1, 47-53(1967). (In Russian).

A graphical method is outlined for constructing MHD generator channel characteristics in conjunction with finite difference solutions of the MHD equations. The method uses lumped parameters from the generalized Ohm's law, such as the relation between the two vectors E and J. The method is used to illustrate the selection of optimum conditions for the operation of the generator. The results are compared with numerical solutions and are found to be not as accurate. To rectify this shortcoming, the graphical method is combined with the usual finite difference scheme after defining the potential difference between the electrodes, or the total current. The results are again compared with direct numerical methods, using digital computers, and agreement between the two methods is improved. The grapho-analytic method is shown to be applicable to the quasi-one-dimensional MHD channel flow problems. (ATD)

35058 STRUCTURE OF THE MAGNETIC FIELD IN THE WORKING GAP OF A LINEAR MHD MACHINE WITH AN ARBITRARY NUMBER OF POLES AND FINITE LENGTH OF THE MAGNETIC CIRCUIT. Valdmanis, Ya. Ya.; Lielpeter, Ya. Ya. Magn. Gidrodin., No. 1, 115-20(1967). (In Russian).

An approximate model of the stator of an MHD generator is used to derive analytic expressions for the magnetic induction in the working gap. The equations of the field and their solutions are given in terms of the magnetic induction. The conditions under which pulsating fields of the edge effect are absent are found for infinite permeability of the magnetic circuit. The results of an experimental study, corresponding approximately to the case when the winding fully occupies the length of the magnetic circuit, are given. The theoretical model is found to be in good agreement with reality. (ATD)

35059 EXPERIMENTAL STUDY OF A DIRECT-CURRENT MHD GENERATOR. Vasil'ev, V. F.; Karasev, B. G.; Lavrent'ev, I. V. Magn. Gidrodin., No. 1, 105-8(1967). (In Russian).

The results of tests of a dc MHD generator with a channel of constant cross section operating with NaK alloy are given. The flow rate in the working part of the channel reached 40 m/sec. The maximum load current, effective power, and efficiency were 6 kA, 2kW, and 40%. The alloy temperature was 150 to 180°C. The channel of 1Kh18N9T steel had a cross section of 7 × 53 mm

and a length of 150 mm. Measurements of the induction in the magnet gap showed distortion of the field pattern along the channel. This caused the load factor and the electromagnetic efficiency to vary as functions of the velocity and of the external magnetic field. The system for compensation of the "armature" reaction is found ineffective. (ATD)

35060 CALCULATION OF TEMPERATURE FIELD IN CHANNEL WALL OF MHD-GENERATOR WITH SECTION ELECTRODES EMPLOYING EGDA-9/60 INTEGRATOR. Kazakevich, O. Ya. (Scientific-Research Inst. of Power Engineering, Kharkov). Inzh.-Fiz. Zh., 12: 666-8(May 1967). (In Russian).

The temperature distribution in the channel wall of the MHD generator consisting of metallic water-cooled frames—electrodes and thin ($^1/_{10}$ from the electrode pitch) ceramic insulators was obtained by modeling on the resistance paper. (auth)

Fluid Physics

35061 (STI/PUB-128(Vol.3)) ELECTRICITY FROM MHD. VOL. III. Proceedings Series. Proceedings of a Symposium held in Salzburg, 4–8 July 1966. (International Atomic Energy Agency, Vienna, (Austria)). Dec. 1966. 1087p. (CONF-660704-(Vol.3)). IAEA: $21.00; Australian Schillings 543,-; Pound 7.8.2; F Fr 102,90; DM 84,-.

This volume III contains papers on the open cycle such as combustion plasma physics, magnets, materials, stricted flows, experiments and measurements of open cycle systems, and prospects. Separate abstracts were prepared for the papers and they appeared in NSA Vol. 20, No. 22. (W.D.M.)

35062 NONUNIFORM ELECTRICAL CONDUCTION IN MHD CHANNELS. Oliver, D. A.; Mitchner, M. (Stanford Univ., Calif.). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1424-32 (Aug. 1967).

Methods of describing steady electrical conduction in a partially ionized gas with Hall effect, strong applied or magnetically induced electric fields, nonuniform electrical conductivity and nonequipartition electron heating are proposed. The occurrence of nonequipartition heating is shown to lead to the possible development of arbitrarily large conductivity gradients in the gas and an electrical conduction field characterized mathematically by a system of partial differential equations of mixed elliptic-hyperbolic type. The relationship between these steady-state phenomena and previously known instabilities in nonsteady nonequipartition plasmas is discussed. These methods are applied to flowing gases in two-dimensional linear magnetohydrodynamic channels with segmented electrode structures. Detailed numerical solutions for current and potential are obtained. In general, it is found that conductivity nonuniformities lead to a degradation of performance as reflected in increased internal impedance of the conducting gas and depressed Hall voltage. Theoretically obtained distributions of current on electrodes in contact with a nonuniformly conducting gas are found to compare favorably with experimental measurements. (auth)

35063 A STUDY OF KANTOROVICH'S VARIATIONAL METHOD IN MHD DUCT FLOW. Lu, Pau-chang (Case Inst. of Tech., Cleveland). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1519-20(Aug. 1967).

The indirect variational method of Kantorovich is applied to the steady, laminar, fully developed, MHD flow inside a perfectly-insulating rectangular duct. A trial function yields a result that compares well with the exact solution for smaller values of the Hartman number. The reason behind the disagreement for larger values of the Hartman number is discussed. (M.O.W.)

35064 ON THE PROBLEM OF STABILIZATION OF A HOLLOW JET WITH A HOMOGENEOUS MAGNETIC FIELD. Vardanyan, V. A.; Oganesyan, R. S. Magn. Gidrodin., No. 1, 100-4 (1967). (In Russian).

The problem dealing with stability of a hollow jet of conducting liquid in a homogeneous magnetic field is solved by the energy method, assuming infinite conductivity within a linear approximation. The stabilizing field strength is found for a longitudinal field and a transverse field. It is shown that a thick-walled hollow jet is stabilized by weaker magnetic fields than a non-hollow one. (ATD)

35065 DEVELOPMENT OF FLOW OF A CONDUCTING FLUID IN A DIFFUSER. Dzhaugashtin, K. E. Magn. Gidrodin., No. 1, 93-9(1967). (In Russian).

The problem of the development of flow of an incompressible conducting fluid in a diffuser in a transverse magnetic field at low magnetic Reynolds numbers is examined. The equations of the boundary layer are used as the initial system. Using the boundary conditions and methods of operational calculus, the expressions for the longitudinal-velocity profile and the pressure are put in appropriate form, and an equation is given for the point of separation of the boundary layer. The nature of the magnetic effect is found to be determined by the orientation of the field in a plane diffuser. (ATD)

35066 RADIAL OSCILLATIONS OF A CONDUCTING CYLINDER UNDER THE INFLUENCE OF A MAGNETIC FIELD. Krikun, Yu. A.; Kuksa, Yu. G.; Mikel'son, A. E.; Skubitskii, V. N.; Chernyi, Z. D. Magn. Gidrodin., No. 1, 87-92(1967). (In Russian).

An expression is derived for the electrodynamic force causing radial oscillations of a conducting cylinder when axial alternating and constant fields are applied. The alternating field is assumed to be considerably weaker than the constant field. The hydrodynamic equations are used to find the elastic oscillations of the cylinder. As a result of prolonged action of the external periodic force, the solution of the pressure equation takes the form of a steady-state oscillation. (ATD)

35067 TURBULENT MAGNETOHYDRODYNAMIC BOUNDARY LAYER IN A COMPRESSIBLE LIQUID. Ginzburg, I. P.; Skurin, L. I. Magn. Gidrodin., No. 1, 77-86(1967). (In Russian).

The momentum integral method is used to investigate the flow of a turbulent, compressible, electrically conducting fluid in a transverse magnetic field. The magnetic Reynolds number is assumed to be small. To integrate the governing flow equations, the semi-empirical, two-layer concept for turbulent boundary layers is used. The solution is carried out by assuming certain power laws. Analytic expressions are obtained for the local skin friction, total skin friction, and the heat transfer coefficient. Numerical results show that the dependence of both the skin friction and heat transfer coefficient on the magnetic field is weaker in turbulent flows than in laminar flows. (ATD)

35068 ON THE PROBLEM OF CONSIDERING THE MAGNETIC REYNOLDS NUMBER IN ONE-DIMENSIONAL MAGNETOHYDRODYNAMIC FLOWS. Bertinov, A. I.; But, D. A. Magn. Gidrodin., No. 1, 71-6(1967). (In Russian).

An analytic solution is obtained to the problem of plane one-dimensional, steady, MHD flow of a conducting fluid in a transverse magnetic field for $R_m > 1$. It is assumed that two of the channel walls are insulated and the other two form the electrodes. The magnetic induction equation is simplified and the solution is given. Using the results for the field distribution, the various other MHD parameters are calculated, including the power output and the efficiency. (ATD)

35069 ON CALCULATION OF STEADY TRANSLATIONAL FLOWS OF ELECTRICALLY CONDUCTING GAS IN RECTANGULAR AND AXISYMMETRIC MHD CHANNELS WITH A STRAIGHT AXIS. Kozyrenko, V. E. Magn. Gidrodin., No. 1, 61-70(1967). (In Russian).

A method is outlined for calculating the flow of a conducting gas in an MHD channel with rectangular or axisymmetric dimensions. It consists of a generalized approach to inviscid-incompressible MHD flow problems with linear geometries. The solution is posed as a Cauchy problem, and the various electromagnetic and flow parameters are expanded in powers of the MHD stream functions. The boundary conditions on the flow field are given for the rectangular channel and for the axisymmetric channel. For the axisymmetric flow, the magnetic field is assumed to be of the form $H = Br^{-1}$. A set of ordinary differential equations is obtained for the coefficients of the above expansion which is amenable to straight-forward numerical integration. The analysis is shown to be also applicable to MHD channels with slightly curving axes. (ATD)

35070 ON THE PROBLEM OF TRANSITION THROUGH THE SOUND VELOCITY IN AN MHD CHANNEL OF CONSTANT CROSS SECTION. Kolosnitsyn, N. I. Magn. Gidrodin., No. 1, 54-60 (1967). (In Russian).

Sufficient conditions for smooth transitions through the sound velocity of magnetohydrodynamic flow in a channel of constant cross section are examined. The induced magnetic fields are taken into account. The system of MHD equations is reduced and given with boundary conditions. The constructed flow diagram differs considerably from the Roesler-Sears diagram. The total numbers of sound-velocity transitions and their nature are determined. Approximate solutions valid in a certain region near the transition are found. (ATD)

35071 BOUNDARY LAYER GROWTH ON A MAGNETIZED CIRCULAR CYLINDER. Barrett, K. E. (Univ. of Liverpool). Z. Angew. Math. Phys., 18: 331-41(May 25, 1967).

For problems in which the magnetic field at the surface is zero it is shown that one can anticipate that wakes will develop in the Alfven direction for sufficiently large applied field strengths. The situation when the normal field at the surface is large, as for example in the case of a non-magnetized cylinder, has not been re-

solved. The only thing that can be said is that the local Alfven wave formed at the surface dominates the overall Alfven disturbance arising from the uniform field. (auth)

35072 FLOW OF MERCURY IN A TRANSVERSE MAGNETIC FIELD WITHIN CONDUITS WITH CONDUCTIVE AND NONCONDUCTIVE WALLS. Branover, G. G.; Vasil'ev, A. S.; Gel'fgat, Yu. M. Magn. Gidrodin., No. 1, 154-5(1967). (In Russian).

Experiments on mercury flow were conducted. Two rectangular conduits were used, one made of organic glass and the other of copper. The glass lay with its short walls parallel to the magnetic field. Of its 40-cm length, the last 32 cm were located between the poles of an electromagnet. The short walls carried 5 static pressure gauges 5 cm apart. Pressures were measured at Reynolds and Hartmann numbers $2000 \leq Re \leq 8760$ and $0 \leq Ha \leq 151.8$. Data on the resistivity coefficient obtained agreed in principle with those of others. The copper conduit was placed with its long side perpendicular to the field and with 38 cm of its 50-cm length within the field. It was instrumented for pressure gaging as the first one. Measurements were taken at $1480 \leq Re \leq 10{,}000$ and $0 \leq Ha \leq 93$. Data on the resistivity coefficient obtained here correspond to the expression $\lambda = 2.2N$ rather than to the theoretically obtained expression $\lambda = 2N$, where $N = Ha^2/Re$—Stewart's number. (ATD)

35073 HODOGRAPH TRANSFORMATION IN PLANE MAGNETOHYDRODYNAMICS PROBLEMS OF A VISCOUS FLUID. Kozyrenko, V. E. Magn. Gidrodin., No. 1, 152-4(1967). (In Russian).

An approximate method is described for analyzing the flow of a compressible, viscous fluid in a magnetic field. The solution of the flow equations using a hodograph plane is described briefly using a Taylor expansion. (ATD)

35074 SOME REMARKS ON THE THEORY OF JETS OF A CONDUCTIVE FLUID. Tsinober, A. B.; Shcherbinin, E. V. Magn. Gidrodin., No. 1, 150-2(1967). (In Russian).

Published works on the flow of free jets in magnetic fields are briefly reviewed, and a new form for the results for the nondimensional axial velocity is suggested. For a strong magnetic field and at sufficient lengths downstream of the source, inertia terms are neglected and the axial momentum equation is solved analytically for the boundary layer thickness and the centerline velocity. (ATD)

35075 EFFECT OF VELOCITY DISTRIBUTION ALONG A CHANNEL CROSS SECTION ON FLOW MEASUREMENT BY A PULSATING FIELD COUNTER. Kirshtein, G. Kh.; Tsirkunov, V. E. Magn. Gidrodin., No. 1, 141-6(1967). (In Russian).

The effect of velocity distribution in a conductive fluid, flowing through a channel, on a pulsating field flow meter is analyzed. The flow meter consists of an alternating field inductor placed near one wall of a channel of width Δ and of two receiving coils, set a distance τ apart, on the opposing wall. The analysis is carried out in two steps. First, the ratio Δ/τ is assumed small relative to unity. In the second case the gap ratio is assumed to be arbitrary and the currents in the fluid are assumed to be distributed in plane layers. The corresponding velocity dependence is obtained using the vector potential A and an integral equation for small magnetic Reynolds number. The case is then generalized to arbitrary magnetic Reynolds numbers and results are obtained numerically. It is shown that for $Re_m \lesssim 0.75$ in turbulent flow and for $Re_m \leq 0.3$ (for laminar flow) the relative error does not depend strongly on Re_m. (ATD)

Geophysics

Refer also to abstract 34513.

35076 (CONF-670429-1) DAYTIME AURORAS AND POLAR CAP AURORAS. Akasofu, S.-I.; Meng, C.-I.; Kimball, D. S. (Alaska Univ., College. Geophysical Inst.). [1967]. 31p.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

Characteristics of the auroras which appear in the day sector of the auroral oval (daytime auroras) are studied by reviewing earlier studies and by supplementing them on the basis of analyses of all-sky films. The significance of their very high occurrence frequency and of the poleward migration after their formation is discussed. Auroras which appear inside the oval (polar cap auroras) are also studied in the same way. It is pointed out that there are a number of morphological features of these auroras to be studied further, preferably by a fast airplane. (auth)

35077 (CONF-670429-3) PRESUNRISE HEATING OF THE IONOSPHERE AT ARECIBO DUE TO CONJUGATE POINT PHOTOELECTRONS. Kwei, M. W.; Nisbet, J. S. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). [1967]. 15p.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

In winter, as has previously been reported, the electron temperature at Arecibo starts to increase prior to local sunrise following illumination of the conjugate ionosphere. The mechanism of this increase is examined. The roles played by heat conduction along the field line and by photoelectrons which traverse the field line are investigated. Photoelectron fluxes, calculated in the manner described by Nisbet (1967), were used to examine the mechanism of pre-sunrise heating at Arecibo. Detailed analyses are made of the escaping photoelectron flux from the conjugate region including the effect of elastic collisions with neutrals in confining the photoelectrons. Comparisons between the theoretical heat input and observed energy losses in amient electrons are presented. Also the theoretical and measured heat fluxes are compared. (auth)

35078 (CONF-670429-4) NEUTRAL ATMOSPHERIC TEMPERATURES FROM INCOHERENT SCATTER OBSERVATIONS. Scientific Report No. 290. Nisbet, John S. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Feb. 16, 1967. 34p.

From 48th Annual Meeting of American Geophysical Union, Washington, D. C.

A method is described for calculating neutral atmospheric temperatures from the data provided by incoherent scatter sounding of the ionosphere. The basis of the method is the use of the data to solve the thermal continuity equation for the ions. In this way the difference between the ion and neutral temperatures can be determined as a function of the heat flow from the ions to the neutral particles and the neutral particle densities. It is shown that under suitable circumstances the neutral temperatures can be determined quite accurately. The method has at present the unique advantage that temperature fluctuations can be followed continuously throughout a day at one location. Calculated values of neutral temperatures for several days derived from incoherent scatter sounding measurements at Arecibo are presented. It is shown that for the days analyzed the time of the diurnal temperature maximum was at 16 ± 1 hours, the diurnal minimum at 4 ± 1 hours and the average day-to-night temperature ratio was $1.36 \pm .03$. (auth)

35079 (NP-16781, 20-48) SPACE PHYSICS. (University Coll., London (England). Dept. of Physics).

Properties of the ionosphere and neutral atmosphere are discussed. Consideration is given to solar-terrestrial relations represented by the ionosphere. Rocket flights in which the Group participated during the year ending June 30, 1966, are tabulated. The table includes launch date, instrumentation, and type of study. Data are presented on the solar eclipse, ionic composition of the ionosphere, electron temperature in the ionosphere, interaction of a spacecraft with the ionosphere, solar radiation, galactic ultraviolet and x radiation, and the structure of the upper atmosphere. (J.H.M.)

35080 A NUMERICAL SOLUTION OF THE TIME-VARYING DIFFUSION EQUATION FOR THE F2 LAYER. Baxter, Roger G. (Univ. of Sheffield, Eng.). Planet. Space Sci., 15: 701-13(Apr. 1967).

The continuity equation for the electron density in the F2 layer of the ionosphere is considered. This is a linear second order nonhomogeneous partial differential equation. A general method of solution of the equation when diffusion, production, loss and time-dependence are included is given. This is achieved by making two substitutions and integrating along a field line, using the Crank Nicolson [Proc. Camb. Phil. Soc., 43: 50(1947)] method to advance the integration timewards. A worldwide distribution of the maximum electron density is obtained and the results are discussed in connection with results obtained by other authors. (auth) (UK)

35081 CONDITIONS NEAR THE NEUTRAL POINTS ON THE MAGNETOSPHERE BOUNDARY. Spreiter, John R.; Summers, Audrey L. (Ames Research Center, Moffett Field, Calif.). Planet. Space Sci., 15: 787-98(Apr. 1967).

Conditions near the neutral points are examined from the conventional point of view of fluid flow around a magnetosphere that must adjust its boundary shape in such a way that the gas pressure of the stream is balanced by the magnetic pressure of the bounded geomagnetic field. It is shown that the latter requirement leads in a natural way to the concept of hot, but essentially stationary, plasma trapped in a cusp-shaped region in the vicinity of each neutral point. It is shown, moreover, that there is a flux of about 10^{32} protons/sec from each region and that this flux is proportional to the velocity of the solar wind. The area through which these particles stream is inversely proportional to the number density

of the solar wind and depends on the angle between the dipole axis and the solar wind direction in such a way that the proton flux may be concentrated into an area 8 times smaller in the summer polar region than the winter polar region. Recent geophysical observations from polar regions, as well as data from laboratory and space experiments, are cited to support the actual existence and physical relevance of the results. (auth) (UK)

35082 SEASONAL VARIATIONS OF IONOSPHERIC ABSORPTION DEDUCED FROM A3 MEASUREMENTS IN THE FREQUENCY RANGE 100 TO 2000 kc. Lauter, E. A.; Nitzsche, P. (Observatory for Ionospheric Research, Kuehlungsborn, Ger. Heinrich-Hertz-Inst., Berlin). J. Atmos. Terrest. Phys., 29: 533-44(May 1967).

A3-absorption data in different frequency ranges indicate the existence of real seasonal changes in the plasma structure of the mesosphere region. From enhancements of absorption in winter, dominating on higher frequencies, and in summer, mainly present on lower frequencies, a quasi-semi-annual wave is found on all frequencies. The maxima are thought to be of very different origin. The "winter anomaly" is studied through the pronounced frequency dependence of this phenomenon, which is centered on the months of December and January and is a typical daytime effect situated in the upper part of the D region. On the contrary the summer enhancement is probably an effect in the lowest part of the D region, originating in the pre-sunrise ionisation. If the absorption data are corrected for this (cosmic ray) D-region attenuation, nearly the same exponent of the zenith angle law is found over the entire frequency range, in spite of the fact that the frequency dependence is markedly different between summer and winter. (auth) (UK)

35083 ELECTRIC CURRENT ASSOCIATED WITH POLAR MAGNETIC SUBSTORMS. Scrase, F. J. J. Atmos. Terrest. Phys., 29: 567-79(May 1967).

A study was made of the records of polar magnetic substorms recorded at Lerwick and two neighbouring temporary stations with a view to determining the associated ionospheric current system. The measurements of the horizontal and vertical components of the disturbance vectors and their gradients in the direction of the horizontal component were compared with theoretical values computed for a band of current with a parabolic distribution of intensity across the width, taking into account the effects of induced currents and of return flow at a lower latitude. The main conclusion was that on the average the sub-storms could be accounted for by a system in which the primary current is a polar electrojet flowing westward and it is this intense westerly electrojet which causes the negative bays of the substorms occurring between 22 hr and 05 hr U. T. whereas the positive bays of the substorms occurring between 15 hr and 20 hr are due to the weaker easterly return flow. Estimates of the height, latitudinal extent and strength of the current were obtained. (auth) (UK)

35084 SOME EVIDENCE OF E_s-LAYER EFFECTS UPON 137-MHz RADIO WAVES. Goodman, John M. (Naval Research Lab., Washington, D. C.). J. Atmos. Terrest. Phys., 29: 607-12 (May 1967).

The occurrence of pronounced scintillation of radio waves transmitted from synchronous satellite Early Bird (1965-28A) appears to be correlated with the growth of the E_s layer frequency f_0E_s. The scintillation disturbances are usually short term but occasionally exist for as much as an hour. A number of the disturbances have well-defined quasi-periodic edges although they generally exhibit a noisy spectrum. (auth) (UK)

35085 NIGHTGLOW CONTINUUM EMISSION. Gadsden, M. (Environmental Science Services Administration, Boulder, Colo.). J. Atmos. Terrest. Phys., 29: 603-6(May 1967).

It is suggested that the process $O_3(^1\Delta_g) + O(^3P) \rightarrow O_2 + h\nu$ makes a significant contribution to the continuous emission spectrum of the night sky. (auth) (UK)

35086 ABNORMALLY EARLY APPEARANCE OF ACTIVE AURORAS. Akasofu, S.-I.; Meng, C.-I. (Univ. of Alaska, College). J. Atmos. Terrest. Phys., 29: 601-2(May 1967).

During intense geomagnetic storms, active auroras tend to appear abnormally early in the evening hours in the auroral zone. The phenomenon is a natural consequence of the equatorward expansion of the auroral oval. Active features of auroras can well be explained by westward traveling surges which propagate along the expanded oval. (auth) (UK)

35087 UNZ'S APPLICATION OF SCHLOMILCH'S INTEGRAL EQUATION TO OBLIQUE INCIDENCE OBSERVATIONS. Gething, P. J. D.; Maliphant, R. G. (Government Communications Headquarters, Cheltenham, Eng.). J. Atmos. Terrest. Phys., 29: 599-600(May 1967).

It is shown that an equation given recently by Unz [J. Atmosph. Terr. Phys., 28: 317(1966)], for the calculation of an electron density profile from backscatter observations taken at a constant angle of incidence, is in error. A corrected equation is given and a more general form of the equation is obtained; the more general equation can be applied to other types of oblique data. (auth) (UK)

35088 RADIO AURORAL ECHOES ASSOCIATED WITH SUDDEN COMMENCEMENTS AND THEIR POSSIBLE USE IN MEASUREMENTS OF MAGNETOSPHERIC ION DENSITIES. Brooks, D. (DSIR, Omakau, New Zealand). J. Atmos. Terrest. Phys., 29: 589-97(May 1967).

The characteristics of pulsating radio auroral echoes occurring with sudden magnetic variations, in particular with sudden commencements, are presented and discussed. One special event is used to estimate changes in magnetospheric densities at a time of high magnetic activity. (auth) (UK)

35089 LANGMUIR PROBE FOR THE MEASUREMENT OF ELECTRON DENSITY AND ELECTRON TEMPERATURE IN THE IONOSPHERE. Prakash, Satya; Subbaraya, B. H. (Physical Research Lab., Ahmedabad, India). Rev. Sci. Instrum., 38: 1132-6(Aug. 1967).

A Langmuir probe system has been developed for measurement of electron densities and electron temperatures in the lower ionosphere. While the probe works like the Smith probe, it has various practical advantages. It is an all electron system working on a single floating power supply. This makes the actual system simpler and allows for more thorough prelaunch checkouts while the rocket is on the launch pad. Further, this system can feed an additional guard electrode without the use of any additional electronics. It has greatly helped in reducing the current leakage and the effect of the distributed capacity at the input of the amplifier. Also the sweep used is such that capacitive discharge currents between the sensor and the rest of the system do not appear in that part of the sweep where retarding potential analysis is done for determination of electron temperature. Within this system it is possible to control the sensor voltage with the output of the amplifier and keep it at space potential. In principle this method can be used to determine both the electron density and electron temperature simultaneously and continuously. (auth)

35090 COMPUTATION OF HF GROUND BACKSCATTER AMPLITUDE. Croft, Thomas A. (Stanford Univ., Calif.). Radio Sci., 2: 739-46(July 1967).

An hf backscatter radar system is simulated by a digital computer method which includes the detailed influence of the ionosphere through use of precomputed rays. To ensure a fairly realistic simulation, allowance is made for the following factors: a spherical earth and ionosphere, electron density variations with height and range, absorption which varies with range and ray angle, antenna gain as a function of azimuth and elevation, ground scattering and specular reflection characteristics which vary with range and angle of incidence, and the transmitted pulse shape. The main approximations are (a) that ray theory is used with the assumption that most energy is distributed uniformly between closely spaced ray paths, and (b) that the effect of the geomagnetic field on ray-path range and transit time is neglected. This computer simulation has two main applications. First, it permits the study of idealized backscatter problems by controlled variation of one parameter at a time. For example, a localized irregularity may be inserted in the ionosphere and the backscatter can be calculated with and without it. Second, it is possible to match experimental backscatter with synthetic backscatter for the purpose of evaluating the ground-scatter coefficient or estimating the existing ionospheric structure. This process requires carefully calibrated experimental data because the comparison must be quantitative. Some early results of this work are shown. (auth)

35091 MOTION OF A CHARGED PARTICLE IN THE MAGNETOSPHERE UNDER THE ACTION OF A SUDDEN GEOMAGNETIC IMPULSE. Ershkovich, A. I.; Pletnev, V. D.; Skuridin, G. A.; Chesalin, L. S.; Shalimov, V. P. (Soviet Geophysics Committee, Moscow). J. Atmos. Terrest. Phys., 29: 459-64 (Apr. 1967).

Motion of an individual charged particle under the effect of magnetic disturbance of a sudden pulse type is considered. The equations of motion are written to a drift approximation and integrated numerically. Mean (by longitude) and mean square displacements of a particle depending on L are obtained and are used for compiling the Fokker-Planck equation for the particle distribution function. This equation is solved in the stationary case. The results show that the particle transfer under the effect of sudden pulses can hardly be the sole process responsible for the formation of the outer proton belt. For nonequatorial particles there were cases of the violation of the second invariant apparently due to the presence of the electric field component along magnetic lines of forces. (auth) (UK)

35092 PRECIPITATION OF HIGH-ENERGY PARTICLES INTO THE UPPER ATMOSPHERE AT MEDIUM LATITUDES AFTER MAGNETIC STORMS. Lauter, E. A.; Knuth, R. (Observatory for Ionospheric Research, Kuehlungsborn, Ger.). J. Atmos. Terrest. Phys., 29: 411-17(Apr. 1967).

Photodetachment processes in the lower parts of the D region at solar zenith angles $80° < \chi < 100°$ allow the detection of an electron precipitation of low intensities, which is observed on a couple of days after periods when a storage of high energy particles in the Earth's environment is to be expected. By vlf and lf measurements an additional ionization is observed in medium latitudes during relatively quiet periods after certain magnetic storms. During high refilling periods of the outer radiation belt the electrons leaking out may be observed over periods up to more than 10 days. Occurring after most of the stronger storms the intensity of these aftereffects has a clear dependence on season and latitude. Precipitation effects of this sort are not connected with PCA events, but show correlations with enhancements of geomagnetic pulsations. They disappear fully in latitudes below 50°, as proved by an European lf-A3-absorption network. The occasions of such flux observations are highly variable over the sunspot cycle. Precipitation effects are often intensified during periods of small storms following a period where a storage has been possible. Aeronomic considerations allow an estimation of the precipitation flux. (auth) (UK)

35093 OBSERVATIONS OF LARGE-SCALE COHERENT PULSATING ELECTRON PRECIPITATION EVENTS IN THE AURORAL ZONE, ACCOMPANIED BY GEOMAGNETIC CONTINUOUS PULSATIONS. Ullaland, S. L. (Univ., Bergen); Trefall, H.; Kremser, G.; Bewersdorff, A. J. Atmos. Terrest. Phys., 29: 395-410(Apr. 1967).

Through balloon observations of x-ray bremsstrahlung in the auroral zone pulsating electron precipitation events were found that are coherent over areas of at least several hundred kilometers in both the N–S and E–W directions. During one such event, which was observed simultaneously from three widely separated balloons in 1964, the x-ray intensity peaks were found to be simultaneous within the accuracy of measurement, which was one second or less. The x-ray pulsations had periods between 65 and 100 sec, and lasted for more than two hours around local noon. This noontime pulsating electron precipitation arose nearly out of the cosmic-ray background, and did not seem to be caused by modulation of a continuously existing electron flux. It was accompanied by geomagnetic continuous pulsations, but these did not always show the same period as the x-ray variations. There are indications that the pulsating electron flux and the accompanying MHD wave were related, and that both phenomena may have been generated in the same process through interaction of the solar wind with the sunward side of the magnetosphere. Two probably similar events were observed in 1965, also around local noon. (auth) (UK)

35094 CONTRIBUTION TO THE STUDY OF THE RELATIONS BETWEEN SOLAR AND GEOMAGNETIC ACTIVITIES. Bednarova-Novakova, B. (Inst. of Geophysics, Prague). J. Atmos. Terrest. Phys., 29: 377-84(Apr. 1967). (In French).

Information is presented on the necessary conditions under which geomagnetic storms and disturbances arise, as revealed by observations of the Sun. The new criteria do not conflict with those previously developed, based on other phenomena. On the strength of these new ideas a method for forecasting geomagnetic activity has been elaborated, enabling a sudden commencement to be predicted with great accuracy. It makes possible the forecasting of geomagnetic storms in each period of the solar cycle, and to say in advance whether the onset of a given storm will be sudden or gradual. As examples for the purpose of explaining their origin, use has been made of the sudden-commencement geomagnetic storms of February 11, 1958, September 20, 1959, October 29, 1963, and November 22, 1963. Except for the first, all these storms had been predicted on the basis of observations of the Sun by means of the spectrohelioscope. Furthermore, an explanation is given of the origin of the gradual-onset geomagnetic storm of 6th and 7th October 1960, which had likewise been predicted. On the same principles explanations are given of the geomagnetic quiet period of 19th–25th June 1965, which recurred six times (16th–17th July, 13th August, 8th–9th September, 6th–7th October, 1st–3rd November and 28th–29th November 1965) and of the one that occurred twice—on December 31, 1965 and January 1, 1966 and on 27th–28th January 1966. (auth) (UK)

35095 INJECTION OF SOLAR WIND PARTICLES INTO THE MAGNETOSPHERE IN THE NEIGHBOURHOOD OF A NEUTRAL POINT. Ershkovich, A. I.; Pletnev, V. D.; Skuridin, G. A. (Soviet Geophysics Committee, Moscow). J. Atmos. Terrest. Phys., 29: 367-76(Apr. 1967).

As a result of the interaction of the solar wind with the geomagnetic field, on the noon boundary of the Earth's magnetosphere, high-latitude neutral points are formed in whose neighborhood the injection of charged particles into the magnetosphere is possible. The magnetic field near these points is similar to the cusped magnetic trap. Consideration is given to the motion of an individual charged particle in the field of such a configuration. Due to the great angular anisotropy of the flux of particles injected into the magnetosphere, centrifugal instability should arise. The study of the motion of individual particles makes it possible to construct a model suitable for investigations of collective effects. The development of centrifugal instability leads to a decrease of the magnetic field and the formation of the "neutral region." The size of this region in different models is evaluated. It is shown that within the instability region the decrease of the field strength is about 10 γ. (auth) (UK)

35096 MEASUREMENTS OF ELECTRON AND ION TEMPERATURES BY INCOHERENT SCATTERING. Carru, H.; Petit, M.; Waldteufel, P. J. Atmos. Terrest. Phys., 29: 351-66(Apr. 1967). (In French).

Using a bistatic arrangement transmitting continuous waves, incoherent scatter spectra were obtained from regions between 90 and 550 km. Electronic heating phenomena were observed during sunrise at the magnetic conjugate point, at times before local sunrise. The ratio T_e/T_i of electronic to ionic temperatures lies between 1 and 1.1 during the part of the night preceding the above mentioned phenomena. Moreover, accepting the ionic composition proposed by Johnson [(J. Geophys. Res., 71: 330(1966)] smooth-looking curves were found during the day for electron and ion temperatures. In most cases, the electron temperature increases monotonically with height, but a maximum around 250 km was observed several times, when the electron density at 300 km was exceptionally high. Lastly, thermodynamic equilibrium was observed below 130 km, in contrast to some results obtained by rocket experiments. (auth) (UK)

35097 NATURAL AND FORCED OSCILLATIONS IN THE MAGNETOSPHERE. Selzer, E. (Univ., Paris). J. Atmos. Terrest. Phys., 29: 339-50(Apr. 1967). (In French).

A discrimination between natural and forced oscillations of a given physical quantity—here, the geomagnetic field—cannot have a definite meaning if the space domain to which it is applied is not well defined. In the present case this domain is bounded, conventionally, by the magnetopause. In studying different modes of energy transfer across this surface, the fact that this transfer takes place through an intermediate turbulent layer, is examined. Mechanical and electrical modes of transfer are examined. The discussion demonstrates that different "inertias" must be assigned to the different hydromagnetic oscillations which can be excited in this way. (auth) (UK)

35098 CHARGED PARTICLES SPIRALLING IN AN EXTENDED GRAVITY FIELD AND THE MAGNETOSPHERE. Chvojkova, E. (Astronomical Inst., Prague). J. Atmos. Terrest. Phys., 29: 465-9(Apr. 1967).

An attempt is made to explain some features of the magnetosphere, especially the simultaneous appearance of several phenomena at both magnetically conjugate points. (auth) (UK)

35099 S_q CURRENT EFFECTS ON THE SEASONAL VARIATIONS IN THE E REGION OF THE IONOSPHERE. Hibberd, F. H.; Henderson, T. L. E. (Univ. of New England, Armidale, Australia). J. Atmos. Terrest. Phys., 29: 477-88(May 1967).

The index n that describes the seasonal variation of the E-region critical frequency has been obtained for a large number of IGY stations. Charts are given that show the variation of this index with latitude and local time, for three different longitude zones. The contours of constant n exhibit asymmetries in latitude, time and magnitude. These asymmetries correlate closely corresponding asymmetries in the S_q current system. (auth) (UK)

35100 AN IDEALIZED PROBLEM WITH F2 LAYER APPLICATIONS. Pickering, W. M. (Univ. of Sheffield, Eng.). Planet. Space Sci., 15: 671-80(Apr. 1967).

An idealized problem is solved which illustrates the coupling between neutral air motion and the transport of plasma in a model F2 layer. The magnetic field lines are assumed to be horizontal and the effects of both vertically upwards and vertically downwards Hall drifts are considered. Very slow circulating motion of the neutral air is assumed to take place in a vertical plane parallel to the magnetic field lines. This motion is assumed to be coupled with the diffusive and Hall motions of the plasma. The problem first is studied in detail, and exactly, by assuming the electron density N to be a given function of position. The streamlines of the air motion are drawn and also a parameter $\underline{b}$ which is the ratio of the horizontal component of neutral air velocity to the horizontal velocity of the ions. The parameter $\underline{b}$ is found to lie within the range in which ion drag might be expected to interfere seriously

with the usual form of the F2-layer diffusion equation. It is shown secondly that if only the production and loss functions for electrons are known a nonlinear diffusion equation is produced. It is suggested that in future theoretical F2-layer calculations it may be necessary to construct a more complicated diffusion equation of this type, allowing for curvature of the field lines. The results indicate that for calculations of the magnitude of neutral air winds affected by ion drag it may be a good approximation to assume that the horizontal ion velocity is the same as the horizontal neutral air velocity. (auth) (UK)

35101 ON THE ASSOCIATION OF "AURORAL" RADAR ECHOES WITH THE AURORA. Gadsden, M. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). Planet. Space Sci., 15: 693-700(Apr. 1967).

New data are presented on the association of the so-called "auroral" vhf-backscattering regions and optical emissions from the regions containing the backscattering centers. The lack of direct association found in earlier work is confirmed. The relevance of this to the two-stream plasma instability hypothesis is discussed. (auth) (UK)

35102 INFLUENCE OF HIGH-LATITUDE DISTURBANCES ON VLF PROPAGATION. Egeland, A.; Naustvik, E. (Norwegian Inst. of Cosmic Physics, Oslo). Radio Sci., 2: 659-67 (July 1967).

The influence of high-latitude disturbances on propagation conditions for radio waves below 12 kHz and above 15 kHz is discussed. The vlf phase and amplitude measurements were carried out at Isfjord Radio, Spitzbergen (geographic coordinates 78°4′ N 13°38′ E). The principal findings may be summarized as follows: There is a high correlation between auroral absorption and disturbed vlf propagation conditions. Furthermore, radio waves between 10 and 12 kHz are much more sensitive to moderate ionospheric disturbances than waves above 15 kHz. During a weak PCA event, which was hardly detected by riometers, strong and long-living vlf phase and amplitude anomalies were recorded. The major vlf effects were observed during daylight periods, which is contradictory to earlier published data. During the maximum disturbances, the vlf reflection layer was probably depressed by more than 25 km for the paths north of 65° geomagnetic latitude. The observed vlf phase and amplitude changes are compared with measured and calculated electron-density profiles. From this comparison some conclusions concerning diurnal changes in reflection heights as a function of ionospheric activity may be drawn. (auth)

35103 RESONANCES OF THE THIN-SHELL MODEL OF THE EARTH-IONOSPHERE CAVITY WITH A DIPOLAR MAGNETIC FIELD. Large, David B.; Wait, James R. (Inst. for Telecommunication Sciences and Aeronomy, Boulder, Colo.). Radio Sci., 2: 695-702(July 1967).

A coupled multimode analysis technique is applied to a model of the earth–ionosphere cavity at elf in which the ionosphere is replaced by a thin, anisotropic shell. The unique feature of the analysis is that it is capable of illustrating the effects of a dipolar form of geomagnetic field. Numerical values of the cavity resonant frequencies and quality factors for several values of electron density and collision frequency are presented for both a homogeneous and a dipolar magnetic field configuration. The main purpose of the study is to demonstrate that a coupled multimode analysis is applicable to such nonsymmetrical configurations. (auth)

35104 CHARACTERISTICS OF THE SOLAR WIND: MAGNETOSPHERE TRANSITION REGION. Scarf, F. L. (TRW Systems, Redondo Beach, Calif.). pp 38-9 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

Previous studies of the shock transition between the magnetosphere and the solar wind are reviewed. Results of simultaneous IMP-2 and OGO-1 measurements of interplanetary and transition region positive ion distributions are shown. Interplanetary, transition region, and magnetospheric search coil power spectra are compared. (J.H.M.)

35105 PLASMA INTERACTIONS WITH A DIPOLE MAGNETIC FIELD. Rubin, A. G. (Air Force Cambridge Research Lab., Bedford, Mass.). pp 40-1 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

Laboratory modeling experiments are being conducted in order to study the low shock produced from the interaction of solar wind with the Earth's magnetic field. One such experiment is discussed in which a collisionless shock is established and some of the conditions necessary to its formation are probed. (J.H.M.)

35106 LABORATORY SIMULATION OF THE SOLAR WIND-MAGNETOSPHERE INTERACTION. Osborne, F. J. F.; Bachynski, M. P.; Gore, J. V. (RCA Victor Co. Ltd., Quebec). pp 42-3 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

Geophysical simulation experiments conducted to investigate the interactions of solar wind with the Earth's magnetic field are reviewed. Information is included on quasi Van Allen belts and polar blobs, the magnetic field at the time of maximum field compression along the sub-solar line, and the magnetic field in the equatorial plane at the time of maximum compression of the field. (J.H.M.)

35107 TURBULENCE OBSERVED IN THE LABORATORY MODELING OF PLASMA FLOW OVER A MAGNETIC DIPOLE. Bostick, W. H.; Grunberger, L.; Emmert, G. (Stevens Inst. of Tech., Hoboken, N. J.). pp 44-5 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

Previous studies indicate that the size and shape of the "geomagnetic" cavity observed from photographs and measurements of plasma flow over magnetic dipoles are in qualitative agreement with the theoretical prediction of Beard. Laboratory modeling information is presented on the turbulence observed in the boundary of the cavity and in the cavity itself. (J.H.M.)

35108 LABORATORY MODELING OF THE SOLAR WIND. Patrick, R. M.; Pugh, E. R. (AVCO Research Labs., Everett, Mass.). pp 46-7 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

Flow problems associated with the interaction of solar wind with the Earth's magnetic field are discussed. The laboratory facility (plasma wind tunnel) which produces a steady stream of high-velocity, collision-free plasma is described. (J.H.M.)

35109 K-BAND OBSERVATIONS OF VENUS AND JUPITER DURING 1966. Staelin, D. H.; Reifenstein, E. C. (Massachusetts Inst. of Tech., Cambridge). pp 138-9 of NEREM Record. Northeast Electronics Research and Engineering Meeting, Boston, November 2–4, 1966. Volume VIII. Newton, Mass., Ernest E. Witschi, Jr., 1966.

See CONF-661127.

As part of a search for resonant features, the microwave spectrums of Venus and Jupiter were observed from Jan. to March 1966 at wavelengths near 1 cm, where H_2O, NH_3, and other resonances are located. The observations were made with the 28-foot paraboloid antenna at M.I.T. The radiometer was a five-channel system operating simultaneously at 19.0, 21.0, 22.235, 23.5, and 25.5 GHz. The planetary measurements were calibrated by comparison with lunar observations. (W.D.M.)

35110 CHARACTERISTICS OF IONOSPHERIC E_S PROPAGATION AND CALCULATION OF E_S SIGNAL STRENGTH. Miya, Kenichi; Sasaki, Tetsuo (Kokusai Denshin Denwa Co., Ltd., Tokyo). Electron Commun. Jap., 48: No. 12, 101-11(1965).

Studies are reported on vhf signal propagation in the ionosphere, and measurements obtained in Japan compared with data from the United States. The results showed that for sporadic-E (E_S) propagation, the reflection points in the ionosphere, as observed in the Far East, are distributed over a wide range. It is pointed out that the received strength of E_S signals can be evaluated if the ratio between the operating frequency and the highest frequency observed in sporadic-E sounding is known. It is also pointed out that the attenuation with distance does not obey the simple secant law. A study is also reported on 2-hop E_S reflected signals. The results revealed additionally that when highly directional antennas are used there is a decrease in effective antenna gain, corresponding to the aperture-to-medium coupling loss in scatter propagation. The amount of this loss was shown experimentally. The characteristics are given in 3 charts to provide a convenient method of calculating the E_S field strength to a distance of 4000 km. Consideration is also given to the reception rate for E_S signals. (BBB)

35111 TEMPORAL AND SPATIAL CHARACTERISTICS OF AURORAL ZONE X-RAY MICROBURSTS. Parks, George Kung. Berkeley, Calif., Univ. of California, 1966. 97p.

Thesis.

Observations of electron precipitation phenomena were made using high altitude balloons in the summers of 1964 and 1965 from Flin Flon, Manitoba, Canada (geomagnetic latitude = 64.5°). The specific objectives of the experiment were to obtain accurate in-

formation regarding the spatial and temporal characteristics of electron precipitation in the auroral zone, with special emphasis on the x-ray microbursts. The effects of atmosphere on the bremsstrahlung x rays were minimized in the conduct of the experiment. To minimize the contribution of scattered photons, detectors were physically collimated with aluminum–lead sandwich (1.1 gms/cm^2 lead) to give a field of view corresponding to an 8° half-opening angle, (corresponding to a circle of 20 kms in diameter at 100 kms altitude) and the payloads were carried to extreme altitudes (2–3 gms/cm^2 atmospheric depths) using large volume balloons. At these altitudes, scattered photons contributed less than 3% of the direct x-ray fluxes. The narrow collimation of the detectors, in addition to reducing the scattered x rays, also reduced the atmospheric x-ray background fluxes, thus permitting the study of the weaker, more frequently occurring x-ray fluxes. An array of three narrowly collimated detectors, each viewing a separate part of the sky, was used in 1964. Each telescope pointed 30° from the zenith and 120° apart in the azimuth direction. In 1965, a fourth telescope was added to the telescope assembly. This telescope pointed in the zenith direction. All quantum energies greater than 15 keV were counted; the zenith-pointing telescope distinguished x-ray energies between 15 to 30 keV and those greater than 30 keV. The observation of microbursts using the telescope arrays revealed some important features regarding electron precipitation phenomena. The spatial extent of microbursts at the electron stopping heights (90 to 100 km) is for a large number of events about 40 ± 14 km in radius; for some events, the source regions are less than 20 km in radius. The microburst occurrence patterns sometimes showed little resemblance in time–intensity profile from one part of the sky to the next. The counting rates of the different detectors varied and the microburst peak counts sometimes differed by more than a factor of 10. The distribution of microbursts as observed by balloon-borne detectors depended on the location of the balloon with respect to the source centers. In all of the events, the north-pointing telescope generally detected the most intense and the largest number of microburst events. There are indications of rapid motions with the individual microburst source regions. They move in random directions at 10 to 100 km/second, and only occur 5% of the time. The x-ray event of September 16, 1965 shows that electron precipitation regions sometimes undergo a slower motion. This motion was from west to east with a velocity of about 250 to 300 meters/second. Microbursts occurred in time coincidence with this event, thus indicating that these two phenomena were somehow related. Temporal analysis of microburst events shows that microbursts tend to occur in groups. There are two distinct types of group occurrences: groups of microbursts are either superposed on the smooth and unchanging background x-ray fluxes, or they are superposed on x-ray pulsations of about 3 to 8 seconds duration. The pulsations are typically spaced 10 seconds apart and the microbursts which are superposed on them are typically spaced by 0.6 second. The meaning of characteristic times associated with microburst events is discussed in terms of a model for the origin of microbursts. (Disser. Abstr.)

Low-Temperature Physics

Refer also to abstracts 34418, 34910, and 35217.

35112 (COO–1112-113) EXPERIMENTS ON CHARGED QUANTIZED VORTEX RINGS IN He(II). Gamota, George (Michigan Univ., Ann Arbor). 1966. Contract AT(11-1)-1112. 142p. Dep. CFSTI.

Thesis.

Results of two experiments on charged quantized vortex rings in superfluid He are reported: a direct measurement of the size of the rings as a function of their energy, and a study of the interactions of oppositely charged beams of quantized vortex rings at various temperatures. The size measurement supported the hypothesis that classical equations can be applied to the behavior of quantized microscopic entities. Preliminary results of the interaction experiment at low temperatures indicated that the vortex–vortex interaction cross section is proportional to the geometrical area and is approximately one order of magnitude larger. At higher temperatures, a threshold temperature was found, which can be interpreted to mark a switchover from the vortex ring to the free-ion domain. Two theoretical problems pertaining to the experiments are considered; an axially symmetric approach of a vortex ring to an aperture in the wall, and the interaction of paired vortex lines. (A.G.W.)

35113 (LA–3414) JOSEPHSON TUNNELING IN SUPERCONDUCTORS. Gruenberg, Leonard W. (Los Alamos Scientific Lab., N. Mex.). June 1965. Contract W-7405-eng-36. 20p. Dep. CFSTI.

The pseudospin model of superconductivity is discussed and applied to a discussion of Josephson tunneling between superconductors. (auth)

35114 RESISTIVITY OF HARD SUPERCONDUCTORS SUBJECTED TO AN INCREASING FIELD. Druyvesteyn, W. F. (Philips Research Labs., Eindhoven, Netherlands). Phys. Lett., 25A: 31-2(July 17, 1967).

The electrical resistivity of type-II superconductors subjected to an increasing magnetic field is discussed in terms of flux pinning and viscous motion of the flux lines. (auth)

35115 HALL ANGLE OF VARIOUS SUPERCONDUCTING NIOBIUM–TANTALUM ALLOYS IN THE MIXED STATE. Niessen, A. K.; Staas, F. A.; Weijsenfeld, C. H. (Philips Research Labs., Eindhoven, Netherlands). Phys. Lett., 25A: 33-5(July 17, 1967).

A probably general decrease with increasing magnetic field of the Hall angle in the mixed state is found only if pinning and guided motion do not disturb the true Hall effect. (auth)

35116 EFFECTIVE SUPERCONDUCTING HAMILTONIAN FOR ALLOYS WITH MAGNETIC IMPURITIES. Appelbaum, J. (Bell Telephone Labs., Murray Hill, N. J.); Celli, V.; Zuckerman, M. J. Contract AFOSR-1138-66. Phys. Lett., 25A: 24-5 (July 17, 1967).

It is shown that, in alloys containing magnetic impurities, the effective coupling constant of the BCS interaction is changed by terms proportional to the concentration of impurities when the Anderson Hamiltonian is transformed into an antiferromagnetic exchange interaction between the impurity spins and the conduction electrons. (auth)

35117 SIMULTANEOUS AC AND DC CURRENTS IN RING-SHAPED TYPE-II SUPERCONDUCTORS. Easson, R. M.; Hlawiczka, P. (Glasgow Univ.). Phys. Lett., 25A: 53-4(July 17, 1967).

Further experiments on ring-shaped type-II superconductors confirm the coexistence of critical ac currents and superimposed dc currents with qualifications regarding sample geometry. (auth)

35118 TIME-DEPENDENT GINSBURG–LANDAU EQUATIONS FOR SUPERCONDUCTING ALLOYS WITH PARAMAGNETIC IMPURITIES. Brusberg, M. (Deutsche Akademie der Wissenschaften, Berlin). Phys. Lett., 25A: 57-8(July 17, 1967). (In German).

A differential equation for the order parameter Δ for alloys with paramagnetic impurities in time-dependent electromagnetic fields was derived under the assumption that Δ is small. (auth)

35119 HIGH MAGNETIC FIELDS. Parkinson, D. H. (Royal Radar Establishment, Malvern, Eng.). Contemp. Phys., 8: 235-49(May 1967).

There has been increasing interest in the use of and methods of generating high magnetic fields, which has been further stimulated by the discovery of hard superconductors. It is technically feasible but likely to be very costly to generate steady magnetic fields of about 400 kOe using conventional means. The use of superconductors seems limited, on thermodynamical grounds, with known materials to fields up to about 220 kOe. Beyond about 450 kOe the pulsed field technique will remain the only possible one for a long time to come. The pulses shorten in duration as the field intensity increases. Already fields of about 10^7 Oe can be produced lasting for about a microsecond. (auth) (UK)

35120 ABSORPTION OF ULTRASOUND IN A SUPERCONDUCTOR ON TAKING INTO ACCOUNT THE OVERLAPPING OF ENERGY BANDS. Fal'ko, I. I. (Kharkov State Univ.). Fiz. Metal. Metalloved., 23: 391-9(Mar. 1967). (In Russian).

The effect of transitions between zones of pairs of electrons with opposite-polarity spins and momenta on the absorption of longitudinal ultrasound in a superconductor with overlapping energy bands is dealt with. A formula for determining the ratio between the absorption factors of the ultrasound in superconducting and in normal states is derived for the case where the distance from the chemical potential to the top and bottom of both zones is greater than or of the order of Debye energy, thus confirming the empirical ratio proposed by R. W. Morse (IBM J. Res. Develop., 6: 58(1962)) and making an allowance for the existence of multiple gaps in the energy spectrum of the superconductor. It is shown that the system of equations for Green's functions describing the properties of a metal in superconducting state may be directly derived from the equations of motion of Heisenberg's operators. (ATD)

35121 OPTICAL PROPERTIES OF SUPERCONDUCTING TECHNICAL ALLOYS OF NIOBIUM WITH TITANIUM. Lekaina, I. E.; Motulevich, G. P.; Fedotov, L. N.; Shubin, A. A. (Lebedev Inst. of Physics, Moscow). Fiz. Metal. Metalloved., 23: 511-15 (Mar. 1967). (In Russian).

The optical constants (index of refraction n and index of absorption χ) of specimens of superconducting Nb–Ti alloys 50BT (50% Nb + 50% Ti) and 65BT (66% Nb, 33% Ti plus traces of Zr and Ta), were measured in the IR portion of the spectrum, within the 1- to 10-μ wavelength range, and the findings were utilized to determine the concentration N_{opt} of conduction electrons, the density $g(E_F)$ of s-electron levels at the Fermi surface and the effective electron–electron collision frequency ν. The measurements of optical constants were performed by the polarization method according to Motulevich and Shubin (Opt. Spektrosk., 2: 633(1957)). The values of $g(E_F)$ calculated according to the concentration of valence s-electrons are lower for the alloy 50BT than for the alloy 65BT, which is interpreted as an additional indication that the concentration of conduction electrons in the metal in reality does not coincide with the concentration of s electrons calculated for free atoms. The effective collision frequency ν for these alloys is several times as high as that of Sn and Pb and nearly one order of magnitude higher than that of Nb. Such a high ν is largely due to the scattering of electrons on the static lattice. The findings on N_{opt} are compared with the critical temperature T_c of the transition of metals to superconducting state and it is established that an increase in N_{opt} increases T_c. Both the investigated alloys display a normal skin effect. (ATD)

35122 METHOD OF THE CORRELATION FUNCTION IN THEORY OF SUPERCONDUCTORS. V. ELECTRIC CURRENT DENSITY. Lueders, Gerhart (Univ., Goettingen, Ger.). Z. Naturforsch., 22a: 845-56(June 1967). (In German).

The electric current density in a superconductor is calculated up to second order in the pair potential. The current density can be formulated in terms of the classical distribution function in phase space which was introduced in previous papers. The resulting expression is specialized both to the Ginzburg–Landau approximation and to the diffusion approximation. The current distribution at the critical fields H_{c2} and H_{c3} is also discussed. (auth)

35123 SUM RULE AND COLLECTIVE DESCRIPTION. Nishiyama, Toshiyuki (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 37: 1029-30(May 1967).

An expression for the phonon spectrum of the interacting boson system is compared with the author's results for the same phenomena. They are found to be in good agreement even though the earlier work was obtained by using the sum rule for the dynamical form factor, while the collective description was followed in this approach. A discussion of improving the results for a large wave number excitation is also given. (L.B.S.)

35124 DEPENDENCE OF THE CRITICAL CURRENT ON THE MAGNETIC FIELD STRENGTH AND EXPERIMENTAL REGULARITIES IN THE CHARACTER OF THE DESTRUCTION OF THE SUPERCONDUCTIVITY OF NIOBIUM BY A CURRENT AND A MAGNETIC FIELD. Chizkov, A. Kh. Zh. Tekh. Fiz., 37: 774-80(Apr. 1967). (In Russian).

An oscillograph technique was employed to record over 2500 oscillograms of the destruction by a current in the presence of a magnetic field of the superconductivity of different niobium samples. Some 150 curves of critical current versus magnetic field strength were also recorded. The measurements were performed at 4.2°K on niobium specimens of different degrees of purity, with different grain sizes, under different mechanical deformations, and with values of the ratio of the resistivity at 293°K to the resistivity at 10°K ranging from 8 to 45. The critical current versus magnetic field strength curves fell into four principal classes with intermediate types. The curves were complex, and six different critical magnetic field strengths could be distinguished at which the character of the curve changed. Not all the critical magnetic fields were evinced by all the curves. It is suggested that the superconductivity may be due to different mechanisms in the different magnetic field regions. The character of the transition to the normal state with increasing current depended on the external magnetic field strength, and the changes in the nature of the transition were closely associated with the changes in the character of the critical current versus magnetic field curve. Both discontinuous and smooth transitions were observed, as well as transition curves in which smooth portions alternated with discontinuities. These variations in the transition curves and the critical current curves and their relations to each other and to the characteristics of the specimen (composition, heat treatment, grain size, and mechanical strain) are discussed at some length. No complete explanation of the observed behavior can be given at present, but it is concluded that heating of the specimen by the current cannot be the principal factor determining the behavior of the specimen at all stages of the transition. (ATD)

35125 AMPLITUDE-INDEPENDENT ULTRASONIC ATTENUATION IN SUPERCONDUCTING LEAD. Fate, W. A.; Shaw, R. W. (Rensselaer Polytechnic Inst., Troy, N. Y.). Phys. Rev. Lett., 19: 230-3(July 31, 1967).

Measurements of the amplitude-independent longitudinal ultrasonic attenuation in superconducting lead are reported. The results are in good agreement with the calculations of others which show that the phonon-limited electron mean free path is different in the normal and superconducting states while the impurity-limited mean free path is the same in the two states. (M.O.W.)

35126 THERMOMAGNETIC EFFECTS IN SUPERCONDUCTING NIOBIUM. Fiory, A. T.; Serin, B. (Rutgers-The State Univ., New Brunswick, N. J.). Phys. Rev. Lett., 19: 227-9 (July 31, 1967).

Observations of a Peltier effect and an Ettingshausen effect in pure niobium are reported. These observations cannot be explained in terms of a simple fluxoid model, and they suggest that in the flux flow state the normal current makes a contribution to the entropy flow. (M.O.W.)

35127 MEASUREMENTS OF ANGULAR MOMENTUM IN SUPERFLUID HELIUM. Hess, G. B.; Fairbank, W. M. (Stanford Univ., Calif.). Phys. Rev. Lett., 19: 216-18(July 31, 1967).

A rotational Meissner effect was shown for liquid helium, analogous to the magnetic Meissner effect in superconductors. Liquid helium in a rotating cylinder is cooled through the lambda temperature. At sufficiently slow rotational speeds, the superfluid forms in a state of 0 total angular momentum, causing the container to rotate faster. (auth)

35128 THRESHOLD FOR SUPERFLUID VORTEX LINES IN A ROTATING ANNULUS. Bendt, Philip J.; Donnelly, Russell J. (Univ. of Oregon, Eugene). Phys. Rev. Lett., 19: 214-16(July 31, 1967).

An experimental observation of the onset of quantized vortex lines in a rotating annulus of He II has been made. The results agree with the predictions of Donnelly and Fetter which were based on a free-energy approach, provided care is taken to ensure equilibrium. (auth)

35129 FORMATION OF THE MACROVORTEX STRUCTURE IN HARD SUPERCONDUCTORS. Iwasa, Y.; Williams, J. E. C. (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Lett., 11: 58-60(July 15, 1967).

Measurements of the field at the surface of a magnetized hard superconducting wire have shown that the application of a local perturbation precipitates the sequential formation of a spatially periodic magnetization (macrovortex structure) along the axis of the wire. (auth)

35130 PURE AND APPLIED CRYOGENICS. VOLUME 5. LIQUID HYDROGEN. An International Series Edited by the International Institute of Refrigeration and Published by Pergamon Press. New York, Pergamon Press, 1966. 393p. $10.00. (In English and French).

Twelve lectures are presented on the following subjects: critical phenomena in fluids, properties of liquid hydrogen, liquid hydrogen in nuclear rocket testing, propulsion by liquid oxygen and hydrogen, structural cryogenic vessels of rocket stages, role of chemical propellants in the NASA lunar exploration program, liquid hydrogen in tonnage quantities, liquid hydrogen storage and handling equipment, industrial achievements of liquid hydrogen distillation, liquid hydrogen engineering instrumentation, applications of liquid hydrogen in electrical engineering, and nuclear applications of liquid hydrogen. (M.O.W.)

Plasma and Thermonuclear Physics

Refer also to abstracts 34385 and 34386.

35131 (CONF-670104–Pt.2) PROCEEDINGS OF CONFERENCE ON PHYSICS OF QUIESCENT PLASMAS, FRASCATI, JANUARY 10–13, 1967. PART II. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati). Feb. 1967. 337p. Dep.

Separate abstracts were prepared for 23 of the 27 included papers. For abstracts of the remaining 4 papers see CONF-670104 in the report number index. (M.O.W.)

For abstracts of individual papers see: 35132, 35133, 35140–35144, 35155–35164, 35192–35195, 35200, and 35201.

Confinement and Heating of Plasma

35132 (CONF-670104–Pt.2, pp 543-62) ELECTRON CYCLOTRON RESONANCE HEATING OF ALKALI PLASMAS. Levine, A. M.; Kuckes, A. F.; Motley, R. W. (Princeton Univ., N. J. Plasma Physics Lab.).

A method has been developed for heating the electrons in a thermally generated alkali plasma by the resonant absorption of electromagnetic waves at the electron cyclotron frequency. The

electron temperature was increased from 0.2 to ~1.0 eV with the application of ~1 W of power at a frequency of 10 kMc. Excellent consistency has been found between diamagnetic measurements of plasma pressure, microwave determinations of plasma density, and double-probe determinations of temperature. The observed temperature increases were in quantitative agreement with computations which consider the heat loss by thermal conduction. (auth)

35133 (CONF-670104–Pt.2, pp 627-32) HEATING SYSTEM WITH PROGRAMMABLE RADIAL PROFILE OF TEMPERATURE FOR THE END PLATES OF A Q-DEVICE. Enriques, L.; Garosi, F.; Neri, A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati).

The heating system for the plates of a large-diameter Q device and the results obtained in the testing of the apparatus are described. The plates are heated by thermal radiation instead of by electron bombardment. This type of heating solves the critical problem of uniformity, reproducibility, and azimuthal symmetry of the plate temperature profile. (M.O.W.)

35134 (IPP–2/62) ANOMALOUS DIFFUSION OF AN AFTERGLOW-PLASMA. Dodo, T. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). May 1967. 22p. Dep.

The diffusion of a helium plasma produced in a metal chamber is investigated as a function of the magnetic field strength and neutral gas pressure. The magnetic field strength is varied from 200 to 3000 gauss and the neutral gas pressure is varied from 2×10^{-2} to 1×10^{-1} torr. A plasma is produced by a narrow electron beam on the central axis of the vacuum chamber. A Langmuir probe is inserted into the chamber off the central axis. The plasma density at the probe is very low at first and increases to a maximum and decreases as the plasma diffuses outward. The diffusion rate of the plasma is obtained direct from the time at which the plasma density reaches a maximum. When $\omega_{ci}\tau_{in}$ is smaller than 1, where ω_{ci} is the ion cyclotron frequency and τ_{in} is the collision time between the ions and the neutral gas, the dependence of the diffusion coefficient on the magnetic field strength is in good agreement with the theory of classical ambipolar diffusion, although the absolute value is one order of magnitude higher. When $\omega_{ci}\tau_{in}$ is larger than 1, the density fluctuations of the plasma appear. The diffusion is anomalous and its dependence on the magnetic field strength is described by Bohm-type diffusion. (auth)

35135 (IPP–4/35) IMPULSKONDENSATOREN. (Energy Storage Capacitors). Kunze, R.-C. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr. 1967. 16p. (In German). Dep.

In fast current devices the capacitive energy storage system is subjected to different load conditions according to the current program. The causes for faults in pulsed capacitors and the possibilities of increasing the capacitor-life are discussed. In addition a survey of properties of pulsed capacitors recently used in the IPP is given. (auth)

35136 CONFINEMENT OF HIGH-TEMPERATURE PLASMA BY THE HELIOTRON MAGNETIC FIELDS. Uo, K. (Kyoto Univ.). Electrotech. J. Japan, 8: 48-53(1963).

Confinement of a high-temperature plasma by a magnetic field, referred to as the Heliotron field, is described. This field is produced by electric current in a series of paired coils wound around a discharge tube at regular intervals. The electric current in each coil of the pair differs both in intensity and direction. The lines of force in this field undulate near the tube axis without cutting the wall, while those near the tube wall intersect the wall. Thus a high temperature plasma could be produced by ohmic heating in the central region of this field, and the plasma prevented from touching the wall. This field was found to satisfy the necessary condition for equilibrium. The interchange instability of the plasma confined in this field is discussed. A general expression is given for the magnetic field, and it is shown how the Heliotron B magnetic field, the cylindrical cusp field, the helical winding field of the Stellarator, and the Picket-Fence field are derived as special cases of this general formula. (BBB)

Diagnostics of Plasma

Refer also to abstract 34503.

35137 (CEA-R-3133) DIFFUSION COHERENTE D'UNE ONDE ELECTROMAGNETIQUE PAR UN CYLINDRE DE PLASMA INHOMOGENE. (Scattering of Electromagnetic Waves by an Non-Uniform Cylindrical Plasma). Faugeras, Paul Etienne (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1967. 99p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Orsay, France.

The problem of the scattering of plane electromagnetic waves from a nonuniform, cylindrically symmetrical plasma is solved analytically, by a self-consistent field method, for a wave with the electric field parallel to the cylinder axis. Numerical results for the diffracted field are plotted for interesting ranges of the parameters involved: diameter, density on the axis, radial profile of the density, and collision frequencies. The case where the incident field is cylindric (waves surfaces parallel to the cylinder axis) is examined: this permits to connect theoretical calculations and experimental diffraction patterns, and also to explain the diffraction effects observed in a classical microwave interferometry experiment. These results, and the possibility of measuring exactly the diffracted field (showed by experiments with dielectric and metallic rods) lead to a new plasma diagnostic method, based on the diffraction, which has no theoretical limitations and is usable when the classical free-space wave methods are not (plasma diameter lower than 10 wave lengths). The feasibility of this method is tested with a plasma at atmospheric pressure and a 2 mm incident wavelength. The plasma is obtained by the laminar flow of a plasma torch, with a working gas (He or Ar) seeded by potassium (density continuously variable between 10^{11} and 10^{15} e/cm^3). Some diffraction patterns by this plasma and for various incident waves are also given and explained with theoretical calculations. (auth)

35138 (CEA-R-3237) APPORT DE L'ELECTRO-OPTIQUE AUX ETUDES SUR LE PLASMA. (Contribution of Electro-Optics to Plasma Research). Dillet, Alain; Jacquot, Claude; Stevenin, Pierre (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). June 1967. 30p. (In French). Dep.

Two electro-optical devices useful for plasma diagnostics are described. The first includes two image converters and is able to record any luminous transient phenomenon (for instance, fast spectrography) with a photon gain sufficient to distinguish the physically observable luminous thresholds. The second makes use of the Faraday effect to measure magnetic fields without perturbation. A fast device has a pass band up to 30 MHz. A slower one can detect 1" of arc. (auth)

35139 (CONF-661041–6) MEASUREMENTS ON A PLASMA FORMED BY INJECTION OF ENERGETIC IONS INTO A MAGNETIC QUADRUPOLE FIELD. Brandt, B.; Huizenga, W.; Vis, Adri; Strijland, W.; de Kluiver, H. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Oct. 1966. 18p. (IR–66/023). Dep.

From 1st European Conference on Controlled Fusion and Plasma Physics, Munich, Germany.

Different methods for plasma diagnostics are discussed. The main topics are microwave interferometers and electrostatic probes. The methods are used to determine the electron density in the cusp of a magnetic quadrupole field. (M.O.W.)

35140 (CONF-670104–Pt.2, pp 523-30) DENSITY MEASUREMENTS IN A Q-DEVICE BY RESONANCE FLUORESCENCE SCATTERING, LANGMUIR PROBE, AND MICROWAVE METHODS. Hashmi, M.; van der Houven van Oordt, A. J.; Wegrowe, J. G. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)).

Earlier measurements of density by means of the resonance fluorescence scattering and the Langmuir probe have shown a large discrepancy between these two methods, where the spectroscopic method yielded lower values than the probe. Comparison between recent measurements of the density by resonance fluorescence scattering, microwave and Langmuir probe methods is presented and discussed. (auth)

35141 (CONF-670104–Pt.2, pp 531-42) OPTICAL STUDY OF A BARIUM Q-PLASMA. Motz, R. O.; Rogers, K. C.; Bates, A. D. (Stevens Inst. of Tech., Hoboken, N. J.). (NYO–2813-38).

Optical techniques are applied to the investigation of a barium plasma to study excited state population, ion density and optical thickness, wave detection, self-luminosity, and collision cross section. (M.O.W.)

35142 (CONF-670104–Pt.2, pp 563-78) PROBE TECHNIQUES FOR LOW-DENSITY PLASMAS. Chen, Francis F. (Princeton Univ., N. J. Plasma Physics Lab.).

The use of electrostatic probes in thermally ionized cesium and potassium plasmas has many problems because of the extremely low densities and temperatures which are encountered. The problem of frequency response of the probe and its circuitry, which arises when a probe is used for measuring fluctuations, is discussed. (M.O.W.)

35143 (CONF-670104–Pt.2, pp 579-87) MEASUREMENT OF SPACE AND TIME EVOLUTION OF THE DISTRIBUTION FUNCTION. Frank, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

An electrostatic separation probe has been designed to measure the electronic velocity distribution function. This method is used

to study experimentally the correlation between the slope of the distribution function, in the field where it is positive, and the plasma oscillations. It is shown that the evolution of the distribution function is related to the growth of the plasma oscillations. In certain conditions the observed results can be interpreted on the basis of the quasi-linear theory. (auth)

35144 (CONF-670104-Pt.2, pp 589-98) POLARIZED PYROMETRIC PROBE PRINCIPLE AND EXPERIMENTAL DETERMINATION OF THE CHARACTERISTICS OF THE PARTICLES OF AN ENERGETIC PLASMA. Bardet, Rene; Geller, Richard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

The polarized pyrometric probe is an electrostatic probe which is thermally isolated and made of tungsten or carbon. In contrast to the Langmuir probe, its working characteristic is beyond the ionic and electronic saturation knees. In hot and dense plasmas (where the use of an ordinary Langmuir probe is difficult), the radiation power of the probe is compared, deduced from the temperature determined with a pyrometer, to the VI product of the characteristic. The energy and densities of the plasma particles were then determined. An experimental verification for fast ions is given. (auth)

35145 (IPP-1/60) REAKTIONSNEUTRONEN ALS HILFSMITTEL DER PLASMADIAGNOSTIK. (Neutrons from d-d-Reactions as a Tool for Plasma Diagnostics). Lehner, G.; Pohl, F. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1967. 33p. (In German). Dep.

The neutrons from d-d-reactions in a hot deuterium plasma can be used for plasma diagnostic purposes. The ion velocity distribution is responsible both for the total rate of neutron production and the energy spectrum of the neutrons. Anisotropic velocity distributions give rise to neutron fluxes and neutron energy spectra which are also anisotropic. These effects are discussed for generalized Maxwellian distributions (characterised by different parallel and perpendicular "temperatures") and for monoenergetic distributions (three and two dimensional), which serve as typical examples. (auth)

35146 (IPP-1/61) UNTERSUCHUNG DES DYNAMISCHEN VERHALTENS EINES STOSSFREIEN PLASMAS IM VERLAUF EINER THETA-PINCH ENTLADUNG MIT BERUECKSICHTIGUNG STOSSFREIER ENERGIEDISSIPATION. (Investigation of the Dynamics of a Collisionless Theta-Pinch Plasma with Respect to Anomalous Energy Dissipation). Igenbergs, P. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr. 1967. 54p. (In German). Dep.

The dynamic behavior of a collisionless, weakly diamagnetic plasma with electron densities between 10^{11} and 10^{13} cm^{-3} was studied during a theta pinch discharge in order to investigate possible collisionless dissipation mechanisms. This was done by treating a special model numerically and comparing it with experimental results. The measurements were made with a 4-mm microwave interferometer end-on and side-on and with magnetic field probes. Besides giving the electron density at the beginning of the discharge, the microwave measurements give the possibility to obtain an estimate of their time variation in the region near the axis. Eight magnetic field probes were applied at various radial points. From measurements made by a difference method it is possible to find the radial distribution of the current density during the theta pinch discharge. The initial electron distribution can be determined from the rise with time of the current density at various points. The time variation of the azimuthal electron velocity can be determined from the spatial distribution of the electron density and the probe measurements. With these measurements limits can be given for the ratio $v_{e\varphi}/v_{th}$ in the time interval up to the first compression, $v_{e\varphi}$ being the directed azimuthal electron velocity and v_{th} the thermal electron velocity. These limits result if two extreme conditions are imposed when evaluating the measuring results: assuming that $v_{e\varphi}/v_{th}$ is spatially constant one obtains for $v_{e\varphi}/v_{th}$ values of about 1, and assuming that the initial density is spatially constant one can determine a lower limit for $v_{e\varphi}/v_{th}$ of about 0.3. (auth)

35147 (IPP-3/53) UNTERSUCHUNGEN AN TRANSFORMATIONSGLIEDERN ZWISCHEN HOHLLEITERN UND LECHERDRAEHTEN IM 3cm-GEBIET. (Investigations on Matching Transitions Between Waveguides and Lecher Wires in the 3cm Region). Klingenberg, H.; Makios, W.; Meinhold, G.; Siddiqui, A. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Mar. 1967. 27p. (In German). Dep.

The Lecher system was used to measure the parameters of a plasma produced in a shock tube. Investigations of the system in the 3-cm region showed that most of the input power is radiated into free space. The Lecher wires themselves radiate hardly any power; radiation occurs mainly at the openings of the transitions required for converting the $H_{1,0}$ wave of the waveguide into the transverse wave of the Lecher line. The radiation losses vary with the standing-wave-ratio and the position of the nodes relative to that of the radiating element. Fluctuations were measured which could cause an error of ±10% in measurements of the plasma parameters. These include fluctuations, also due to standing waves, which take the form of variations of the ohmic losses in the components of the system (error ±5%). The reflection losses were reduced by appropriate dimensioning (with good matching) to 40% of the input power. (auth)

35148 (ORNL-4089) SOUND WAVES IN PLASMAS: A BASIC PHENOMENON AND A SIMPLE DIAGNOSTIC TOOL. Jones, Wm, Denver (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 26p. Dep. CFSTI.

Some experimental aspects of ionic sound waves are discussed. A brief history and discussion is given of some of the more important ionic-sound-wave work. The experiments at the Oak Ridge National Laboratory are discussed in some detail. Note is made of the plasma diagnostic capabilities of these waves. (auth)

35149 HIGH-FREQUENCY RESONANCE PROBE. Peter, Guenter (Institut fuer Plasmaphysik, Garching, Ger.). Z. Naturforsch., 22a: 872-90(June 1967). (In German).

Dc and ac currents to a rf resonance probe were investigated experimentally in the frequency range from 1 to 100 Mc in a quiescent cesium plasma. The measurements in the plasma are explained by calculations and measurements with a lumped-constant equivalent network ("plasma simulator"). It is shown that the ac current to the probe is strongly influenced by the capacitance of the cable leading to the probe. A device to compensate this cable capacitance is developed and used. Furthermore, it is shown for the first time that the double (or divided) main resonance maximum, occurring frequently with dc and ac currents to the resonance probe, is generally due to the influence of a second reference electrode. A simple and direct ("focus") method for very precise plasma density determination (from the intersection point of the rf-current-vs.-frequency curves with probe voltage as parameter) is developed and compared with ac transmission current and Langmuir probe measurements at plasma densities between 2×10^6 and 3×10^7 cm^{-3}. Agreement is obtained between these three experimental methods within their margins of error. The comparison leads to a better understanding of the measured Langmuir characteristic and of the Cs plasma of the "Alma I" device. (auth)

35150 FRACTIONAL-FRINGE HOLOGRAPHIC PLASMA INTERFEROMETRY. Jahoda, F. C.; Jeffries, R. A.; Sawyer, G. A. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Appl. Opt., 6: 1407-10(Aug. 1967). (LA-DC-8226).

Holographic interferometry can be applied to plasmas whose density results in shifts of less than one fringe by superposing the small shifts on an arbitrarily shaped and positioned background fringe pattern. The sensitivity of holographic interferometry, while the inherent advantages of holography are retained. The background fringes also simplify detection of the spurious phase changes that can arise in holography from motions of the apparatus. (auth)

Kinetics of Plasma

35151 (AD-654026) PLASMA CYCLOTRON ECHOES. Smith, Thomas B. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). May 1, 1967. Contract DA-28-043-AMC-02536(E). 29p. (RLE-TR-458). CFSTI.

A single-particle model is presented that is sufficient to explain observed radiation peaks from weakly ionized laboratory plasma immersed in a magnetic field subsequent to one, two, or three short driving rf pulses at the gyro frequency. It is shown that, depending upon the regime of operation, these echoes can result from any combination of arbitrary speed dependences in the gyro frequency, collision frequency, or diffusion of the electrons between and after the pulses. (auth)

35152 (BMwF-FBK-67-49) UNTERSUCHUNGEN AN DRAHTEXPLOSIONEN, STOSSWELLEN UND PINCH-ENTLADUNGEN. (Investigations of Exploding Wire Phenomena, Shock Waves, and Pinch Discharges). Meiners, D. (Technische Hochschule, Hanover (West Germany). Institut fuer Plasmaphysik). June 1967. 20p. (In German). Dep.

The following different problems are treated: (1) Exploding wire phenomena at high voltage and high ambient gas pressure. (2) Investigation of electric discharges along a laminar jet of condensed gas. (3) Construction of a 200 kJ Θ-pinch experiment for measuring line broadening by linear Stark effect. (4) Enhancement of shock wave velocity by heating the gas within the driver section of a conventional shock tube by means of a discharge initiated by an exploding wire. (auth)

35153 (CEA-R-3081) INTERACTION FAISCEAU-PLASMA DANS UNE DECHARGE PENNING A CATHODES FROIDES. (Beam-Plasma Interaction in a Cold-Cathodes Penning Discharge). Bliman, Samuel Lazare (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1967. 123p. (In French). Dep.

Thesis. Submitted to Univ. of Paris, Orsay, France.

The hf emissions from a cold-cathode reflex discharge are studied. An experimental law for the frequency variation shows that $f \alpha V^{\frac{1}{2}}$ discharged if B_0 and p are constant. If B_0 is made to increase, the frequencies change such that $f_{ce} - f_{emitted}/f_{ce}$ decreases. With each emitted frequency there is associated a stationary wave system making it possible to measure the phase velocity V_ϕ of the waves. This phase velocity is always close to that of the fast electrons accelerated by a potential V. A non-quasistatic formalism for the propagation of waves in a beam-plasma system is then established. The Maxwell equations are solved taking into account boundary conditions. Comparison of these experiments with the theory shows a satisfactory agreement. (auth)

35154 (CEA-R-3122) CALCUL DU GLISSEMENT DE LA FREQUENCE DE RESONANCE D'UNE CAVITE CHARGEE PAR UN PLASMA EN PRESENCE OU NON D'UN CHAMP MAGNETIQUE STATIQUE. (Calculation of the Resonance Frequency Change for a Cavity Charged by a Plasma With or Without a Static Magnetic Field). Melin, Gerard (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar. 1967. 33p. (In French). Dep.

In the case of a cold plasma with or without static magnetic field, two methods are given for calculation of resonance frequency shift and absorption in a cylindrical cavity crossed by a plasma column: (1) a perturbation method, already known and used for electronic density measurements, is restated and its application is used for several high-frequency cavity modes; and (2) an exact method employing Maxwell's equations, which however necessitates a computer, is compared with the first one; it permits a determination of the validity limits of the perturbation method and drawing of conclusions. (auth)

35155 (CONF-670104-Pt.2, pp 325-34) NONLINEAR PROCESSES IN A BOUNDED MAGNETIZED PLASMA. Perulli, Mariano (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires).

The three nonlinear wave processes in a plasma, in a strong magnetic field, were investigated. The diameter of the hydrogen plasma column is about 2 cm, the length 100 cm, and the density variable up to 10^{10} cm^{-3} and the fluctuations of electron density are: $\Delta n/n \simeq 10$ to 20%. The electron temperature is 6 eV and the magnetic field is 2,000 to 10,000 gauss. The neutral density in the chamber in which the plasma diffuses is approximately $n_0 \simeq 10^{13}$ cm^{-3}. Therefore the plasma can be considered to be collisionless for the frequencies considered. The waves are excited in the plasma by a Langmuir probe connected to an oscillator. (M.O.W.)

35156 (CONF-670104-Pt.2, pp 335-47) STATIONARY ELECTROSTATIC CONFIGURATIONS DUE TO PRESENCE OF NEGATIVE IONS. Enriques, L.; Wong, H. V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati).

In experiments on discharges in electro-negative gases, a dark, stationary band has been observed sitting in the discharge. This dark band is absent for discharges in electro-positive gases, and is apparently linked with the presence of negative ions. Its width is of the order of the electron Debye length of the plasma. The light intensity emitted by the discharge is proportional to the density of excited atoms, and hence is intense where the electron density is large. The dark band therefore demarcated a region of comparatively low electron density. Thus, a potential profile in this region should show a potential well. It is demonstrated that the presence of negative ions in a plasma can lead to the formation of a stationary potential well whose width is of the order of the Debye length. Its relevance to the experiments is discussed. (auth)

35157 (CONF-670104-Pt.2, pp 361-9) EXPERIMENT ON DESTRUCTION OF COHERENT MOTION IN A QUIESCENT PLASMA. Brunelli, B.; Iannuzzi, M.; Righetti, G. B. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati).

An experiment on thermal dissipation of directed energy in a thermally ionized cesium plasma is described. An effect of excitation of plasma oscillations which destroys the drift motion of electrons is observed. The mechanism of this effect is discussed. (auth)

35158 (CONF-670104-Pt.2, pp 463-73) DISPERSION AND DAMPING OF ELECTRON PLASMA WAVES. Barrett, P. J.; Jones, H. G. (United Kingdom Atomic Energy Authority, Abingdon (England). Culham Lab.); Franklin, R. N. (Oxford Univ. (England)).

The propagation of electron plasma waves along a cylindrical plasma column in a strong magnetic field has been studied both theoretically and experimentally. The dispersion equation for such waves has been solved numerically where the plasma density profile is assumed to be either uniform or parabolic and the electron energy distribution Maxwellian. Dispersion and damping curves have been computed for the m = 0 azimuthal mode. These are compared with experimental points obtained from a thermally ionized plasma over the range of electron density 10^8 to 10^{10} cm^{-3} with B = 3000 gauss. (auth)

35159 (CONF-670104-Pt.2, pp 475-89) COLLISIONLESS ABSORPTION OF ELECTROSTATIC PLASMA WAVES. Decker, J. F.; Hirshfield, J. L. (Yale Univ., New Haven, Conn.).

Measurements are described of the absorption of rf energy by a plasma column surrounded by a periodic coupling structure. The structure imposes an eleven wavelength (quasi) electrostatic standing wave upon the plasma with essentially one value of wave vector $\underline{k}$ and continuously adjustable values of frequency ω. The power absorption is proportional to $(v\, \partial f_0/\partial v)_{v=\omega/k}$ corrected for the finite length of the structure, where $f_0(v)$ is the unperturbed electron distribution function. Similarities between this absorption process and the Landau damping of a temporarily decaying uniform plasmawave are evident. Measurements of non-Maxwellian distributions $f_0(v)$ in PIG discharges by this method, together with measurements of strong rf noise emission, give results consistent with theories of turbulent noise generation. Application of strong rf signals to the structure produces time-average nonlinear distortion of the distribution function of a beam drifting through the structure. This induced distortion compares favorably with theoretical predictions of a quasi-linear theory. (auth)

35160 (CONF-670104-Pt.2, pp 511-20) OSCILLATIONS OF AN INHOMOGENEOUS PLASMA. De Barbieri, O. (Milan Univ. (Italy). Istituto di Fisica).

The WKB approximation is utilized to solve the linearized Vlasov equation for an inhomogeneous one-dimensional plasma. The real and imaginary parts of the propagation vector of a high frequency plasma wave are computed. (auth)

35161 (CONF-670104-Pt.2, pp 317-24) COOPERATIVE EFFECTS IN CYCLOTRON ECHO PHENOMENA. Wong, A. Y.; Judd, O. (California Univ., Los Angeles. Dept. of Physics).

A simple model is suggested in which cooperative effects among electrons in the presence of a radial density gradient are possible mechanisms to bring the electrons out from coherence and to provide a distribution of frequencies to explain the narrowness of the observed echo pulse. (M.O.W.)

35162 (CONF-670104-Pt.2, pp 397-409) ION ACOUSTIC WAVES IN A CESIUM PLASMA. Wendt, John F.; Cambel, Ali Bulent (Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.).

The design and operating characteristics of an alkali metal plasma generator operating in the vapor pressure mode are described. Also, the results of an experimental study in which electrostatic waves at kilocycle frequencies were propagated through the plasma and parallel to the confining magnetic field are discussed. (M.O.W.)

35163 (CONF-670104-Pt.2, pp 411-23) EXCITATION OF ELECTROSTATIC OSCILLATIONS NEAR THE ION CYCLOTRON FREQUENCY. Levine, A. M.; Kuckes, A. F. (Princeton Univ., N. J. Plasma Physics Lab.).

The results of a computation which analyzes the stability of current flowing from an electrode, through a plasma sheath, into a magnetized plasma are presented. The details of the computation are not presented. The complete derivation is outlined and the theoretical results are presented and compared with experiments. (M.O.W.)

35164 (CONF-670104-Pt.2, pp 355-60) ION WAVE PROPAGATION IN A CURRENT CARRYING CESIUM PLASMA. Doucet, H. J.; Gresillon, D. (Ecole Polytechnique, Paris (France)).

Some preliminary results of a current carrying plasma obtained in the machine PASCAL, a Q-like machine working in the vapor pressure mode, are presented and the measured phase velocity is compared with the results of the macroscopic linear theory. (M.O.W.)

35165 (IPP-2/61) SOME PHENOMENA OCCURING DURING THE INTERACTION OF AN ELECTRON BEAM WITH A MAGNETOPLASMA. Herrmann, W. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr. 1967. 44p. Dep.

A beam of electrons penetrating a neutral gas creates a plasma with which it interacts. It is shown theoretically that oscillations with frequencies just below the upper hybrid frequency ($\omega_H^2 = \omega p^2 + \omega c^2$) will be excited. In the theory the electrostatic approximation is used, but a study is made of the conditions under which this approximation is valid. Oscillations near the upper hybrid frequency were detected experimentally. An experimental criterion for stability of the beam–plasma was deduced. With increasing density the excited oscillations lead to a turbulent state. This turbulent state of the system is characterized by high energy losses of the beam particles. The electric fields, which cause the energy losses of the beam particles, are concentrated in a small region $d \lesssim 15$ cm behind the entrance slit of the beam in the plasma chamber. Increasing the interaction length does not appreciably change the losses. (auth)

35166 (LA-DC-8124) INTENSE SOURCE OF NEUTRONS FROM THE DENSE PLASMA FOCUS. Mather, J. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 13p. (CONF-670714-1). Dep. CFSTI.

From 2nd International Symposium on Nucleonics in Aerospace, Columbus, Ohio.

The dense plasma focus (created in a coaxial accelerator) is an intense source of neutrons. The plasma focus can be described as a fast dynamic z pinch in which stored magnetic energy is rapidly converted to plasma energy and then compressed by its self magnetic field. Plasma pressures (nkT) of the order of 3×10^{18} atmospheres are developed on axis in a region of ~0.5-mm diameter and 3 to 5 mm in length. The deuterium plasma density $n \simeq 2$ to 3×10^{19}/cc, electron temperature $T \sim 5$ keV and a neutron pulse duration of ~0.15 μsec lead to a large neutron emission which is not inconsistent with the assumption of thermonuclear origin. Scaling of the dense plasma focus to larger input energies and larger physical size should permit on the basis of experimental evidence higher neutron production. The characteristics of this type of source which are relevant to its potential use as a neutron source in experiments are discussed. (auth)

35167 (NYO-2150-27) THE PROPAGATION OF HELICON WAVES UNDER CONDITIONS OF NONLOCAL CONDUCTIVITY. Report No. 676. Houck, James Richard (Cornell Univ., Ithaca, N. Y. Materials Science Center). June 1967. Contract AT(30-1)-2150. 127p. Dep. CFSTI.

Thesis.

The theory of helicon attenuation is developed including both collisional damping and nonlocal effects. The theory predicts a strong nonlocal attenuation for helicons propagating at an angle to the external field, B_0. This damping is similar to the Landau or transit time damping associated with other types of plasma excitations. A series of experiments designed to measure the attenuation of helicon waves propagating in alkali metals is described. The alkali metals were chosen because of the simplicity of the electronic structure. A detailed quantitative comparison between theory and experiment shows very good agreement. The free electron theory is used to calculate the effect of collisions on the nonlocal dispersion of helicons for propagation along B_0. The angular dependence of the nonlocal dispersion is calculated assuming no collisional damping. A series of pulse propagation experiments are described in detail. These experiments are used to check the c.w. attenuation measurements. The pulse experiments are also used to measure the helicon group velocity. (auth)

35168 UTILIZATION OF THE REFRACTIVE INDEX SURFACES TO EVALUATE CHERENKOV RADIATION IN AN INFINITE MAGNETOPLASMA. Sasiela, R.; Freidberg, J. P. (Polytechnic Inst. of Brooklyn, Farmingdale). Radio Sci., 2: 703-10 (July 1967).

The utilization of refractive index surfaces in conjunction with the Clemmow, Mullaly, Allis (CMA) diagram greatly simplifies the determination of the regions of Cherenkov radiation and the types of waves emitted in a cold, collisionless, electron magnetoplasma. Also, the physical insight gained by this approach is used to explain the qualitative behavior of the power spectrum. (auth)

35169 DERIVATION OF THE QUANTUM VLASOV EQUATION AND DISPERSION RELATION OF A RELATIVISTIC ELECTRON GAS. Biskamp, D. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Z. Naturforsch., 22a: 869-72(June 1967).

The selfconsistent field equation (Vlasov equation) is derived for the one-particle Wigner function of a relativistic electron–positron gas. From the linearized form the dispersion relation was obtained for any quasi-equilibrium state, which for the special case of thermal equilibrium has already been derived by Tsytovich. (auth)

35170 RADIATION AND ITS EFFECT ON THE NONEQUILIBRIUM PROPERTIES OF A SEEDED PLASMA. Lutz, Michael A. (Massachusetts Inst. of Tech., Cambridge). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1416-23(Aug. 1967).

For some magnetohydrodynamic applications, it is advantageous to use a nonequilibrium seeded plasma as the working fluid. Such a plasma can be described by a two-temperature model, in which the electron temperature is elevated above the heavy-particle temperature. Because of the large disparity between the masses of the electrons and the heavy particles, the two species are only weakly coupled through elastic collisions. As a result, the radiation arising from inelastic collisions can crucially affect the electron temperature distribution and, as a consequence, the transport properties of the plasma. A local electronic energy balance has been formulated which includes the effect of radiative transport in a nonuniform seeded plasma, described by the two-temperature model. The resulting differential-integral equation has been solved numerically, showing the effect of the radiative transport on the electron temperature distribution between two infinite parallel planes. From this, an exemplary conductivity-current density characteristic has been calculated and compared with existing data. The agreement is excellent. A closed-form expression for the volumetric radiative power loss has been derived for the case of a uniform plasma. In addition, three characteristic lengths have been found which identify the principal mechanism of energy loss in a given enclosure with a given set of operating conditions. It is shown that, under some circumstances, no radiative corrections are required for engineering calculations, regardless of enclosure size. (auth)

35171 EFFECTS OF A MAGNETIC FIELD ON THE PROPAGATION OF ALFVEN WAVES IN A CONDUCTING FLUID. Cristea, M.; Stan, I.; Pop, I. Stud. Univ. Babes-Bolyai, Ser. Math.-Phys., 11: No. 2, 115-20(1966). (In Rumanian).

The effect of the slow variation of the magnetic field on the propagation of Alfven waves in a viscous and incompressible fluid of infinite conductivity was studied. It is shown that for a slow variation of the magnetic field in time, there is a slow variation of the amplitude and the propagation velocity of the Alfven wave. (tr-auth)

35172 KINETIC THEORY OF ELECTROMAGNETIC WAVES IN A LAYERED PLASMA MEDIUM PLACED IN A MAGNETIC FIELD. Kondratenko, A. N.; Onishchenko, I. N. Ukr. Fiz. Zh., 12: 910-18(June 1967). (In Russian).

The propagation of electromagnetic waves in a periodic layered plasma medium in the presence of the constant magnetic field which is perpendicular to the layer boundaries is considered. When the particles reaching the layer boundary are reflected specularly, the solution is obtained with arbitrary parameters, while for the diffuse reflection the case of weak space dispersion is considered. The dispersion equations are obtained from which the conditions of the propagation and attenuation coefficients are determined. For thick layers (the period of a high-frequency field is much smaller than the mean flight time of particles through the layer) the wave attenuation caused by Cherenkov's absorption of energy by electrons is found to be proportional to the cubed mean thermal velocity for the specular reflection and that it is linear with thermal velocity for the case when particles are reflected diffusively. For thin layers the wave attenuation may be considerable for the diffuse reflection and neglected for the specular one. The cases of high frequencies (only electrons are taken into account kinetically) and low frequencies are considered. (auth)

35173 QUANTUM CORRECTIONS TO THE FREE ENERGY OF THE MAXWELL PLASMA. Blazhievskii, L. F.; Yukhnovskii, I. R. Ukr. Fiz. Zh., 12: 924-31(June 1967). (In Russian).

An expression is obtained for the free energy of electron plasma in a compensating field by the method of displacements and collective variables in the case of high temperatures. The regions of the Born approximation and a region of quasiclassicity are considered. (auth)

35174 HOLLOW CATHODE EFFECT MECHANISM. Popovici, C.; Somesan, M.; Nistor, V. (Inst. of Physics, Bucharest). Ann. Phys. (7), 19: 225-33(1967).

On basis of new results concerning the dependence of the discharge current on the intercathode spacing and the cathode fall potential, the main characteristics of the hollow cathode effect (H.C.E.) in a plane-parallel geometry are defined. In order to explain the particularities of the H.C.E., a mechanism is proposed that regards the discharge current amplifications and the enhancement of the negative glow plasma as a consequence of the plasma beam instabilities. (auth)

35175 OSCILLATIONS OF ELECTRIC ARCS IN ARGON CROSS-FLOW. Benenson, David M.; Naeher, Carl H.; Gideon, John B. (State Univ. of New York, Buffalo). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1517-19(Aug. 1967).

The results of an investigation of arc oscillations in argon are reported. The ranges of the various parameters reported are:

constant pressure level 835 mm Hg, electrode spacings from 3.2 to 22.3 mm, current levels from 7 to 34 amps, and average (cold) throughflow speed from 43 to 86 cm/sec. Measurements of the flow field were not obtained. (M.O.W.)

35176 CALCULATION OF THE KINETIC REFLECTION COEFFICIENT IN THE FORMULA OF THE THERMIONIC EMISSION CURRENT FROM A PLASMA OR A SEMICONDUCTOR. Baksht, F. G.; Moizhes, B. Ya.; Nemchinskii, V. A. Zh. Tekh. Fiz., 37: 729-42(Apr. 1967). (In Russian).

Formulas are derived for the calculation of the so-called kinetic connection coefficient which, in the case of the thermionic emission from a plasma or a semiconductor, may significantly alter the Maxwellian electron energy distribution function. At a large distance from the barrier on the boundary of the plasma or the solid, the current is transported essentially by slow electrons under the action of the electric field. However, above the barrier, the current is transported exclusively by the fast electrons. Thus, close to the barrier, there occurs a transformation of the slow electron conductivity current into a fast electron diffusion current. Consequently, the degree of nonequilibrium of the electron energy distribution function at the barrier and the kinetic reflection coefficient in the equivalent problem are determined by the velocity ratio of two processes: the emission of fast electrons and the velocity of the conversion of the slow electrons into fast ones due to nonelastic scattering processes. Calculations of the kinetic reflection coefficients and the nonequilibrium distribution functions are presented for the cases when the electron distribution function strongly differs from the Maxwellian function, and when it differs only insignificantly. An interpolation method is worked out for intermediate cases. (ATD)

35177 EXCITATION OF IONIC SOUND BY A HELICON. Suramishvili, G. I. (Inst. of Cybernetics, Tbilisi, USSR). Zh. Tekh. Fiz., 37: 798-801(Apr. 1967). (In Russian).

The decay of a helicon, propagating in a rarefied plasma in the direction of an external magnetic field according to the dispersion equation $f = (L/4\pi^2P^2)ck^2$ (f is the frequency, k is the wave number, c is the velocity of light, and L and P are the Larmor and Langmuir frequencies, respectively), into a lower frequency helicon and an s-plasmon (ionic sound) is discussed. The calculations are based on the Lagrangian and the second quantization technique. An equation is derived for the rate of transfer of energy to ionic sound waves by a narrow packet of helicons. The helicon frequency must exceed a certain threshold value if this transfer is to take place. (ATD)

35178 NONLINEAR GENERATION OF PLASMA WAVES BY A BEAM OF TRANSVERSE WAVES. III. Tsytovich, V. N.; Shvartsburg, A. B. (Lebedev Inst. of Physics, Moscow). Zh. Tekh. Fiz., 37: 589-601(Apr. 1967). (In Russian).

The hydrodynamic approximation to the nonlinear current was used to discuss the interaction of transverse and longitudinal waves in a plasma and the generation of longitudinal waves by a beam of transverse waves. The general conditions were discussed for the applicability of the random phase approximation (the frequency spread large compared with the reciprocal of the time characteristic of the nonlinear interaction), and the case was treated when one of the interacting waves has random phase and the other has fixed phase. It was found that the logarithmic increment γ for the generation of plasma waves by random phase transverse waves, which increases linearly with the energy W of the transverse waves for small values of W, became proportional to the square root or cube root of W for large values of W. The intensity of the generated plasma waves was highest in the direction perpendicular to the generating beam of transverse waves, and for large values of W the phase of the generated plasma waves ceased to be random. The interaction with the plasma of a strong alternating field with a frequency exceeding the Langmuir frequency was discussed and the stability conditions were derived. These last calculations were of interest in connection with the radiation acceleration of a plasma. (ATD)

35179 OSCILLATIONS OF A NONUNIFORM PLASMA CYLINDER. Arsenin, V. V. Zh. Tekh. Fiz., 37: 607-13(Apr. 1967). (In Russian).

An integral equation was derived for the potential oscillations of a nonuniform rarefied plasma cylinder in a uniform longitudinal magnetic field and its solutions were discussed for different limiting values of the ratios among the wavelength, the ion Larmor radius, the Debye radius, and the length characterizing the nonuniformity of the plasma (the thickness of the transition region at the plasma-vacuum boundary). Drift and cyclotron oscillations were discussed briefly, and characteristic differences between the cases of plane and cylindrical geometry were pointed out. The flute instability of a plasma cylinder with a sharp boundary was discussed in more detail. It was shown that the plasma cannot be stabilized with respect to perturbations proportional to exp (in α) with n = 1 (α is the azimuth angle) by any increase in the ion Larmor radius. (ATD)

35180 EFFECTS OF THE ENTRAINMENT OF PARTICLES BY WAVES. Lyamov, V. E.; Sapogin, L. G. (Taganrog Radio Engineering Inst., USSR). Zh. Tekh. Fiz., 37: 624-32(Apr. 1967). (In Russian).

The entrainment of a group of entities (particles or waves) having a broad momentum distribution and zero average momentum by a beam of other entities having a narrow momentum distribution is discussed in general terms. The processes were classified into four classes, depending on whether the entrained and entraining entities are particles or waves, and examples of each class were mentioned. A fifth class was noted, in which two beams mutually entrain each other, leading to feedback and sometimes to pulsation of the beams. Entrainment phenomena are properly to be treated with the aid of the kinetic equations for both systems, but in some simple cases, some of which were discussed in this paper, the emf produced by the entrainment of charged particles by waves could be calculated more simply. The general equations on which such simplified calculations could be based were derived in two preliminary sections headed "damping of waves as a result of interaction with particles," and "relation between the effect of entrainment and the damping of waves." In these sections the waves were treated as quasiparticles with energy hf and momentum hf/v, where f is the frequency, v is the phase velocity, and h is Planck's constant. The particles having velocities close to the phase velocity of the waves were the most effective in damping the waves. The emf due to entrainment was then calculated for entrainment in waveguides and retarding systems, for entrainment of electrons in conductors by electromagnetic waves, and for interaction of electrons with laser beams. Possible applications for some of the discussed phenomena were suggested. It is suggested that the entrainment of electrons in a hydrogen plasma by a laser beam could be employed to measure the laser beam power. (ATD)

35181 EFFECTIVE ABSORPTION COEFFICIENTS FOR RADIANT ENERGY TRANSPORT IN NONGREY, NONSCATTERING GASES. Patch, R. W. (Lewis Research Center, Cleveland). J. Quant. Spectrosc. Radiative Transfer, 7: 611-37(July-Aug. 1967).

An approximation for integrated intensity in nongrey, nonscattering gases is presented that uses a new mean absorption coefficient in the grey gas transport equation. This absorption coefficient is called an effective absorption coefficient. To test the approximation, the integrated intensities were calculated by exact and approximate methods for 40 cases. The integrated intensities calculated by the effective absorption coefficient approximation had errors of only −25 to +28 percent, which demonstrated the superiority of this approximation over a similar approximation using the Planck mean absorption coefficient. Despite certain restrictions on the form of the spectral absorption coefficient, the effective absorption coefficient approximation is expected to be useful for most problems in LTE nonscattering plasmas, even where large temperature ratios and inhomogeneities are present. (UK) (auth)

35182 INTERACTION OF MAGNETIZED PLASMA BURSTS WITH A "MAGNETIC BARRIER." Azovskii, Yu. S.; Guzhovskii, I. T.; Pistryak, V. M. Zh. Tekh. Fiz., 37: 691-5(Apr. 1967). (In Russian).

The passage of plasma bursts from a conical plasma gun through a nonuniform longitudinal magnetic field was investigated. The plasma bursts, having a charged particle density of some 2×10^{13} cm^3, were fired with a velocity of 6×10^6 cm/sec into a 160 cm long drift tube. A uniform longitudinal magnetic field that reached its constant value of 0.29 kOe at about 40 cm from the plasma gun was maintained in the drift tube. In some experiments there was employed an additional longitudinal magnetic field, the "magnetic barrier," which became appreciable at a distance of about 70 cm from the plasma gun and reached its peak value of perhaps 0.9 kOe at 110 cm from the gun. The characteristics of the plasmas at different points along the drift tube were measured with electric and magnetic probes. When the plasma burst entered the uniform magnetic field its radius decreased from 5 to 2.5 cm, and it became magnetized as a result of damping out of the induced currents. When a magnetized plasma burst traversed the barrier field its radius decreased and subsequently increased but there was observed no further expression of the magnetic field or magnetization of the plasma. The perfectly conducting pliant current loop model of N. A. Khizhnyak was employed to calculate the behavior of the plasma bursts. The calculations were in satisfactory agreement with the experimental results. From this agreement it is concluded that the interaction of the magnetized plasmas with the barrier field was adiabatic. (ATD)

35183 SPREADING OF THE JET OF AN IONIZED GAS ALONG A WALL IN THE PRESENCE OF A TRANSVERSE MAG-

NETIC FIELD. Akatnov, N. I.; Ermolaeva, G. K. Magn. Gidrodin., No. 1, 25-31(1967). (In Russian).

The spreading of a jet of ionized gas along a wall is analyzed in the presence of a transverse magnetic field. Solutions are obtained for a radial as well as a plane jet. Hall currents are included for the radial case but neglected for the planar flow. The stream function and the w-velocity component in the radial flow are expanded in powers of the axial component x, thus leading to a set of double infinite series in f and Θ. Solutions are obtained for values of f and Θ up to third order for three values of the Hall parameter. The results are shown graphically. The shear in the w-direction is given and is found to diminish in the presence of the magnetic field. Similar results are obtained for the plane jet where $\omega\tau \ll 1$. Throughout the analysis the magnetic field is assumed to be a function of x. (ATD)

35184 FLOW OF CONDUCTING GAS AROUND MAGNETIZED BODIES. Tkalich, V. S.; Tkalich, E. F. Magn. Gidrodin., No. 1, 19-24(1967). (In Russian).

The flow of a nondissipative plasma over a magnetized cylindrical body is investigated theoretically. The flow is assumed to have zero circulation and is represented by N-component plasma flow equations. All species in the plasma are assumed to have the same velocity and temperature. It is also assumed that a current flows along the cylinder axis, which is placed transverse to the flow. All electromagnetic fields are assumed to disappear at infinity. The vector potential A and an expression giving the calculated body force on the cylinder are given. This expression is approximated for low and high plasma densities, and it is shown that the induced force is proportional to the square of the current flowing along the cylinder and increases as the current-carrying conductor is brought close to the cylinder surface. (ATD)

35185 FLOW OF IONIZED GAS OVER AN OSCILLATING BOUNDARY IN THE PRESENCE OF A MAGNETIC FIELD. Selezov, I. T.; Selezova, L. V. Magn. Gidrodin., No. 1, 9-18 (1967). (In Russian).

A supersonic flow of a weakly conducting, compressible, ionized gas past a harmonically oscillating plane surface in the presence of a longitudinal or transverse magnetic field is considered. The approximate model of a boundary layer with constant velocity distribution along a section of the surface length considered by J. Mills and Y. C. Fung is generalized to the case of an MHD-boundary layer. The main parameters of an MHD-boundary layer (the velocity in the layer, its thickness, and its conductivity) are determined by solving the problems of flow of viscous and inviscid, conducting gases past a plane oscillating surface. Analytical expressions for velocity and pressure are derived for both longitudinal and transverse magnetic fields. The effect of longitudinal and transverse magnetic fields on the pressure distribution on the oscillating surface is analyzed and evaluated numerically using a computer for various values of flow parameters at M = 1.3 and $M_\delta = 0.65$ (in the boundary layer). The results presented graphically show that the MHD-boundary layer has a substantial effect on the amplitude and pressure phase on the surface, and that the increase in the oscillation frequency in all cases leads to the diminution of the effect of the magnetic field on the amplitude and pressure phase. (ATD)

35186 CALCULATING TWO-DIMENSIONAL UNSTEADY FLOW OF FINITE CONDUCTIVITY PLASMAS IN THE PRESENCE OF HALL EFFECTS. Brushlinskii, K. V.; Gerlakh, N. I.; Morozov, A. I. Magn. Gidrodin., No. 1, 3-8(1967). (In Russian).

The unsteady flow of a plasma in a coaxial channel is analyzed in the presence of magnetic fields, including finite conductivity and Hall effects. The flow is assumed to be isothermal and inviscid, with a radial magnetic field $H = H_0(r_0/r)$. The channel has a variable cross section f(z) such that at the channel exit the following condition is satisfied $\partial Hf/\partial z = 0$. The resulting partial differential equations are solved numerically on a digital computer, using a finite difference scheme, and the results are shown graphically. It is found that the rate at which steady state conditions are attained depends strongly on the plasma conductivity, Hall parameter, and the magnetic pressure number. As the ohmic resistance increases, the effect of Hall currents on the flow decreases. (ATD)

35187 PLASMA WAVE ECHO. Gould, R. W. (California Inst. of Tech., Pasadena); O'Neil, T. M.; Malmberg, J. H. Phys. Rev. Lett., 19: 219-22(July 31, 1967).

It is shown that if a longitudinal wave is excited in a collision-free plasma and Landau-damps away, and a second wave is excited and also damps away, then a third wave (i.e., the echo) will spontaneously appear in the plasma. (auth)

35188 SELF-SIMILAR PROBLEM OF SEPARATION IN ELECTRICALLY CONDUCTING GAS IN A MEDIUM WITH APPLIED AXIAL MAGNETIC FIELD. Volosevich, P. P.; Sokolov, V. S. Magn. Gidrodin., No. 1, 43-6(1967). (In Russian).

Some self-similar solutions are investigated in the flow of inviscid conducting gases where the electric conductivity is a function of temperature and density. The problem is assumed to possess axial symmetry. For $t > 0$, a time dependent magnetic field $H = H_0 t^n$ is applied within the plasma which is bounded by nonconducting walls where $H = H_s$. The boundary conditions for the flow are given by $v(0,t) = 0$, $\partial H(0,t)/\partial r = 0$, $v(r_*,t) = nv_0 t^{n-1}$, $H(r_*,t) = H_0 t^n$. The following conditions lead to self-similar solutions $n = (2k_0 + 1 - n_*)/2(k_0 + g_0 + 1)$, $n_0 = -1$. Using these conditions and the mass conservation law, a set of ordinary differential equations is obtained. Two special cases are considered: the first assumes separation with constant velocity where n = 1, and the second assumes the electric conductivity to depend, explicitly, on time only. The latter yields only one solution where the temperature reaches a maximum at the boundary. (ATD)

35189 STRUCTURE OF ELECTROSTATIC CHARGE IN PULSED PLASMA FLOW. Golovanivskii, K. S.; Dugar-Zhabon, V. D. Magn. Gidrodin., No. 1, 39-42(1967). (In Russian).

The structure of the electrostatic charge transported by pulsed flow of a plasma generated by a coaxial source with condensed discharge is studied experimentally. The electrodes were of kovar and copper, and had diameters of 6 and 28 mm and lengths of 182 and 162 mm. Air was used as the working gas. A 76-μF capacitor bank charged to 10 kV was used. Recordings and photographs were made with three OK-17M double oscillographs. The plasmoids generated were found to have macroscopic electrically charged layers. The first plasmoid had the greater charge. The complex structure breaks down with motion in the tube, and subsequent plasmoids have practically no luminescence. The use of magnetic probes makes it possible to record all plasmoids generated. (ATD)

35190 ELECTROSTATIC POLARIZATION OF THE CYLINDRIC PLASMA LAYER IN AN EXTERNAL STATIC MAGNETIC FIELD. Golovanivskii, K. S.; Pogosyan, V. A.; Torosyan, O. S. Magn. Gidrodin., No. 1, 32-8(1967). (In Russian).

The effect of static magnetic fields and a suddenly applied electric field on a partially ionized plasma is investigated. The plasma is assumed to be cylindric in shape, extending to infinity in its axial direction. The magnetic field is axial in direction, but the E-field is applied radially. The particle concentrations are assumed perturbed slightly as the E-field is applied, and the resulting equations for the ions and electrons are linearized. Solutions are obtained for the radial as well as azimuthal translational velocities of the ions and electrons, using first order Bessel and Neumann functions. The results show that the presence of the magnetic field creates both periodic and aperiodic motions and alters the phase of electron and ion oscillations. The translational motion decays exponentially as in the case of a pure electric field. (ATD)

35191 PRELIMINARY EXPERIMENT OF THE INDUCTION-COUPLED ARGON PLASMA AT ATMOSPHERIC PRESSURE. Ohji, Michio; Akazaki, Masanori; Nakayama, Ryuzo; Sasano, Takao (Kyushu Univ., Fukuoka). Rep. Res. Inst. Appl. Mech. (Kyushu Univ.), 14: No. 47, 1-10(1966).

Correlations between the rf high-temperature discharge and the ambient flow conditions were investigated in some preliminary experiments with Ar gas. The characteristics of rf (3.2 Mcps) induction-coupled Ar plasma at atmospheric pressure were studied with special reference to the condition of gas flow. The method of starting and operation of the main discharge was almost the same as with the Reed plasma torch, but 2 modes of the predischarge could be clearly distinguished: the spiral mode and the pencil mode. The effect of vortex stabilization on the main discharge was confirmed by feeding the gas flow into the discharge tube either tangentially or axially. The dependence of the plate current I_p of the oscillator circuit on the gas flow rate Q, with the plate voltage V_p being fixed, was shown and a V-shaped extinction curve was obtained on the Q–V_p plane. (BBB)

Production of Plasma

Refer also to abstract 35162.

35192 (CONF-670104–Pt.2, pp 601-16) PRODUCTION OF QUIESCENT ALKALI PLASMAS USING POROUS IONIZERS. Dewey, C. Forbes Jr. (Colorado Univ., Boulder. Joint Inst. for Lab. Astrophysics, Boulder, Colo.).

The "Q-Machine" originally developed by Rynn and D'Angelo has proved to be a powerful tool for studying fully ionized plasmas. In practice, the two previous schemes for ion production (collimated atomic beams and high alkali vapor pressure) have exhibited several unsatisfactory features. The use of porous tungsten–tantalum emitters for producing fully ionized plasmas of improved symmetry, reproducibility, and uniformity is described. A theoretical plasma sheath model is derived to predict the operating

characteristics of porous emitters, and the theory is applied to the Q-machine configuration. A compact prototype ionizer has been constructed and is described in detail. (auth)

35193 (CONF-670104–Pt.2, pp 491-509) SYNTHESIZED PLASMA BEAMS AND ELECTROSTATIC INSTABILITIES. Bonnal, J. F.; Chavy Y.; Manus, C.; Spiess, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires).

Creation of a synthesized plasma by injection of electrons from a hot filament (the neutralizer) into a pulsed ion beam is described. The main characteristics of this plasma are discussed: density, temperature, stability. When an electric field is applied, electrons emitted by the neutralizer are accelerated and beam–plasma instabilities are created. The density and energy of the fast electrons are measured by an electrostatic analyzer. The frequencies and wavelengths observed are explained by a hydrodynamical model of the beam–plasma system. The plasma is well adapted to different kinds of studies such as the damping of instabilities by electron–neutral collisions. This is observed by the introduction of different gases (H_2, He, Ar) without changing the characteristics of the plasma. A comparison between experimental results and theoretical models is attempted, emphasis being put on nonlinear processes. (auth)

35194 (CONF-670104–Pt.2, pp 617-25) PRODUCTION OF QUIESCENT CESIUM PLASMA IN A THERMAL IONIZATION CHAMBER. Balfour, D.; Brown, R. (International Research and Development Co. Ltd., Newcastle-upon-Tyne (England)).

Facilities for the production of quiescent cesium plasma were studied and a heated tantalum tube was used to study microwave propagation through a quiescent plasma. A ceramic chamber to produce uniform quiescent plasma was designed and is being developed. (M.O.W.)

35195 (CONF-670104–Pt.2, pp 633-6) INVESTIGATION OF NEW QUIESCENT PLASMAS. Buzzi, J. M.; Doucet, H. J.; Gresillon, D.; Mordin, A. M. (Ecole Polytechnique, Paris (France)).

Some preliminary results on new quiescent plasmas production by surface ionization are presented. The possible materials that can be used and their properties are discussed. (M.O.W.)

35196 SHAPE OF A MAGNETICALLY BALANCED ARC. Goldstein, M. E.; Fay, J. A. (Massachusetts Inst. of Tech., Cambridge). AIAA (Amer. Inst. Aeronaut. Astronaut.) J., 5: 1510-11(Aug. 1967).

A model of stationary arc-type discharges balanced in crossed convective and magnetic fields from which the cross-sectional shape of the arc may be determined is proposed. It is assumed that hot fluid recirculates within the arc column while cold external fluid flows around the column, much as it would flow about a solid body. It is further assumed that the arc can be considered two-dimensional and that the current density is uniform across the cross section of the arc. (M.O.W.)

35197 PULSED ARGON ARCS AT PRESSURES UP TO 1000 ATM. Borovik, E. S.; Kantsedal, V. P.; Knyazev, Yu. R.; Mitin, R. V.; Petrenko, V. I. Zh. Tekh. Fiz., 37: 703-9(Apr. 1967). (In Russian).

Investigation of high pressure pulsed arcs has been extended to pressures up to 10^8 N/m^2. The 2 to 6 cm long arcs between tungsten-tipped electrodes in argon were struck by discharge of a 3 kV 4500 microfarad capacitor through a 0.3 to 0.7 mm diameter copper wire joining the electrodes. The arc current and voltage were recorded with oscillographs, the arc was photographed with a pinhole camera, and the luminous radiation emitted by the arc was recorded. The arcs were some 6 cm in diameter and had the same general appearance as the lower pressure arcs described in the cited papers. The data were processed as in the earlier work. The points representing the electric field strength in the arc column as a function of pressure for an arc current of 40 kA fell on a smooth continuation of the curve representing the earlier lower-pressure data. At the present pressures the electric field strength increases very slowly with increasing pressure; from this it is concluded that the effect of radiation absorption is already so great at these pressures that the radiation losses no longer decrease with increasing pressure. Temperatures of about 4×10^4 °K and charged particle densities of about 10^{20} cm^{-3} were reached. The possibilities of producing higher temperature plasmas by an extension of the present technique are discussed. It is concluded that temperatures of about 10^5°K could be reached without increasing the discharge power by somewhat increasing the pressure, and that higher temperatures can be reached by introducing appropriate impurities to increase the absorption of radiation. (ATD)

35198 INVESTIGATION OF PLASMA PRODUCED IN A MAGNETIC TRAP BY A SUPERHIGH-FREQUENCY FIELD. Anisimov, A. I.; Vinogradov, N. I.; Golant, V. E.; Pakhomov, L. P. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 37: 680-90(Apr. 1967). (In Russian).

The excitation of plasma in helium within a magnetic mirror system by a high frequency field alternating at the electron Larmor frequency was investigated. The plasmas were produced in a 2.6 cm diameter 30 cm long quartz tube with 7 cm long conical ends, which contained helium at pressures from 5×10^{-5} to 10^{-2} mm Hg, by 40 to 250 W 0.1 to 1.5 sec pulses of 3 cm wavelength microwaves propagating in the TE_{11} mode in a 3 cm diameter waveguide containing the tube. Magnetic mirrors with a mirror ratio of 2 were produced near the ends of the tube by a pulsed magnetic field having a rise time of 0.05 sec, a decay time constant of 0.6 sec, and a peak strength on the axis of up to 4 kOe. The microwave power absorbed by the plasma was determined from measurements of the incident, transmitted, and reflected microwaves, and the charged particle concentration of the plasma was measured with a 3 kMHz interferometer. It was found that the plasma efficiently absorbed the microwave power at charged particle concentrations considerably exceeding the critical concentration at which the Langmuir frequency becomes equal to the microwave frequency. Up to 90% of the power was absorbed at charged particle concentrations from 5×10^{11} to 10^{13} cm^{-3}. A charged particle concentration of some 5×10^{11} cm^{-3} with an ionization of 10 to 30% was achieved in the approximately 150 cm^3 volume of the trap with 250 W microwave pulses. The equilibrium charged particle concentration was calculated on the assumption that charged particles are lost from the trap only as a result of collisions of electrons with neutral atoms. The experimental data were in agreement with the calculated dependence of the charged particle concentration on the ratio of the microwave power to the square of the neutral gas pressure. From a comparison of the experimental and calculated results it is concluded that the mean electron energy in the plasmas ranged from about 80 to 160 eV. (ATD)

35199 LASER SPARKS. Gardner, J. W. (English Electric Co., Whetstone, Eng.). New Sci., 35: 15-17(July 6, 1967).

Pulsed, focused laser beams can produce sparks in air. The laser spark is discussed in relation to the interaction of radiation with matter, and some practical applications are mentioned, particularly in the field of switchgear. The practical arrangement employed to produce such sparks is described. Other possible applications include the production of thermonuclear plasmas without large condenser banks, and in the measurement of high gas velocities. (U.K.)

Stability of Plasma

35200 (CONF-670104–Pt.2, pp 349-51) ONE-DIMENSIONAL WEAK PLASMA TURBULENCE. Vedenov, A. A. (Akademiya Nauk SSSR, Moscow. Institut Atomnoi Energii).

The structure of the one-dimensional spectra of turbulent plasmas in Q devices is considered by using the theory of weak turbulence. This work was done in connection with experimental investigations of the spectra. (M.O.W.)

35201 (CONF-670104–Pt.2, pp 447-59) PARAMETER DEPENDENCE OF LOW AND HIGH FREQUENCY INSTABILITIES IN A BEAM–PLASMA EXPERIMENT. Hopman, H. J.; Matitti, T. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atom en Molecuulfysica).

The occurrence of several instabilities in a dc electron beam–plasma experiment is described. The electron beam, which is guided by an axial magnetic field, is not premodulated and creates its own plasma by ionizing collisions with He gas atoms. The instabilities found lie in the vicinity of the ion plasma frequency ν_{pi}, electron plasma frequency ν_{pe} and electron cyclotron frequency ν_{ce}. With a certain set of parameters (i_b, v_b, B) we find the appearance of the instabilities, one after the other ν_{pi}, ν_{ce}, ν_{pe}), on increasing the gas pressure. When the electron cyclotron instability reaches a certain amplitude hf ionization becomes important, and there occurs a jump in plasma density. (auth)

35202 (IPP–6/57) MHD STABILITAET EINES GEWELLTEN THETAPINCHES. (MHD Stability of a Bumpy Theta Pinch). Wobig, H. (Institut fuer Plasmaphysik, G.m.b.H., Garching (West Germany)). Apr. 1967. 11p. (In German). Dep.

Starting from the energy principle of magnetohydrodynamics, the stability of a linear bumpy theta pinch is investigated. The normal mode equations are solved with the help of a perturbation method. (auth)

35203 (NASA-TT-F-436) THEORY OF TURBULENT PLASMA. Achievements of Science: Plasma Physics. Vedenov, A. A. Translation of Teoriya Turbulentnoi Plazmy. Itogi Nauki: Fizika Plazmy, Akademiya Nauk SSSR Institut Nauchnoi Informatsii, Moscow, 1965. 100p. (TT-67-51214; IPST-Cat.-1821). CFSTI.

Topical aspects of the theory of turbulent plasma are discussed. Modern methods of plasma description are applied to investigate small oscillations and plasma stability, as well as the theory of

turbulent nonlinear motions in tenuous high-temperature plasma. (M.O.W.)

35204 PARTICLE ASPECT ANALYSIS OF DRIFT INSTABILITY. Terashima, Yoshinosuke (Univ. of Nagoya, Japan). Progr. Theor. Phys. (Kyoto), 37: 775-85(May 1967).

A physical mechanism of drift instability was studied by investigating the trajectories of the particles. The method is the same as was used by Dawson in his theory of the Landau damping. The plasma particles are divided into two groups, the resonant and nonresonant particles. A drift wave is assumed to have started at t = 0, when the resonant particles are undisturbed. The trajectories of the particles are then computed within the framework of the linear theory. Only those longitudinal waves which propagate obliquely to a static magnetic field in the plane normal to a density gradient are considered. The phase velocity along the magnetic field is assumed to be greater than the mean velocity of the ions, but smaller than that of the electrons. The resonant particles in this case are those electrons which have velocities near to the phase velocity in the direction along the mean magnetic field. It is shown that the rate of energy change of the resonant electrons consists of two terms: one is the usual term arising from the Landau damping and the other the term due to the drift motion of the electrons in the crossed electric and magnetic fields. The latter term is responsible for instability of the wave. The major part of the wave energy is contained in the form of an oscillatory motion of the nonresonant electrons. Discussion of the stabilization by ion's Landau damping and of the drift instability due to impurity ions is given. (auth)

35205 INSTABILITY OF A WEAKLY IONIZED PLASMA INDUCED BY AN ALTERNATING ELECTRIC FIELD. Nishikawa, Kyoji (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 37: 769-70 (Apr. 1967).

The problem of a plasma located in an alternating electric field with the frequency close to the electron plasma frequency was investigated, and it was found that a considerable reduction of threshold power is expected if a weakly ionized plasma with unequal electron-ion temperatures is considered. (M.O.W.)

35206 PARTICLE ASPECT ANALYSES OF ELECTROMAGNETIC AND ELECTROSTATIC INSTABILITIES DUE TO ANISOTROPIC VELOCITY DISTRIBUTIONS. Terashima, Yoshinosuke (Univ. of Nagoya, Japan). Progr. Theor. Phys. (Kyoto), 37: 661-81(Apr. 1967).

Physical mechanisms of electromagnetic and electrostatic instabilities due to anisotropic velocity distributions are studied from the particle point of view. Two familiar examples are analyzed in detail: the unstable cyclotron waves of electromagnetic mode which propagate along a static magnetic field and the unstable electrostatic waves of oblique propagation. The present analyses are based on a physical model similar to that used by Dawson in his theory of Landau damping. The plasma particles are divided into non-resonant particles and resonant ones. Resonant particles are supposed to have some limited value of the velocities along the magnetic field in order to see the Doppler-shifted frequency of a wave under consideration nearly equal to the gyration frequency or its harmonics. The particle trajectories are followed within the framework of linear theory under the initial condition such that the main plasma composed of nonresonant particles has the wave on it while resonant particles are undisturbed. The rate of energy change of resonant particles is thus computed, from which instability criterion can be derived. It is shown that in both processes the physical mechanisms of instability are quite similar. When the mean transverse energy of resonant particles exceeds sufficiently the mean parallel one, they spend more time in losing energy than in gaining energy. In particular on electrostatic instability three typical cases are considered in which physical pictures are different from each other. (auth)

35207 STABILITY OF PLASMAS IN SHORT TRAPS. Arsenin, V. V. Zh. Tekh. Fiz., 37: 614-23(Apr. 1967). (In Russian).

The stability of a plasma in a magnetic trap (magnetic mirror system) of finite length was discussed. The trap was assumed to be short compared with the distance traveled by an ion or an electron as a result of its thermal motion during one period of the perturbing oscillation. The radial oscillations were treated in the "quasiclassical" approximation, i.e., it is assumed that the wavelength in the radial direction is much shorter than the radius of the plasma. As a result of this treatment the boundary conditions on the cylindrical boundary of the plasma did not greatly affect the result. The longitudinal and azimuthal oscillations were treated with the aid of Poisson's equation for the potential and the linearized kinetic equations for the electrons and ions. The boundary conditions at the ends of the trap significantly affected the results. Conditions for flute instability, and for instability of a plasma with hot electrons and of a plasma with cold electrons at harmonics of the ion Larmor frequency, were derived under the assumption that the plasma particles were specularly reflected at the ends of the trap. The condition for flute instability was also derived under the assumption that the plasma particles penetrated somewhat into the region of the mirror before being reflected, the more rapid particles penetrating farther than the slower ones. These stability conditions were discussed briefly and were compared with the corresponding conditions for the case of an infinitely long trap. (ATD)

Shielding

Refer also to abstracts 34742, 35392, and 35397.

35208 (CEA-R-3196) PROPAGATION DES NEUTRONS THERMIQUES DANS DES FAUSSES CARTOUCHES D'ACIER EN HELICE DANS UNE PROTECTION D'EAU. PROGRAMME TOURNESOL III. (Propagation of Thermal Neutrons in Mock-Up Screw-Shaped Steel Elements With Water Protection). Devillers, Christian; Lanore, Jeanne-Marie (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Apr. 1967. 68p. (In French). Dep.

The streaming of thermal neutrons in a cylindrical duct in light water is treated. The duct contains an helicoidal iron shield. Transmission and reflection matrixes are used to describe the probabilities for the thermal neutrons to be absorbed or to be scattered on the surfaces. The neutron paths across the void are represented by geometrical matrixes. The numerical resolution is performed by the Monte Carlo method. (auth)

35209 (NAA-SR-12337(Vol.1)) GRAMS: A FORTRAN PROGRAM TO SOLVE GAMMA RAY PENETRATION PROBLEMS IN MULTISLAB SHIELDS. VOLUME I. NUMERICAL METHODS. O'Reilly, Bruce D.; Lewis, Richard C. (Atomics International, Canoga Park, Calif.). June 22, 1967. Contract AT(04-3)-701. 60p. Dep. CFSTI.

The numerical analytic methods used to solve the one-dimensional energy-dependent transport equation for gamma rays migrating through a multislab shield are described. These methods are organized into a systematic procedure for solving the entire problem. This procedure has been used to develop the FORTRAN Code GRAMS, which implements the numerical solution of the problem. (auth)

35210 (ORNL-3964) AMC: A MONTE CARLO CODE UTILIZING THE ALBEDO APPROACH FOR CALCULATING NEUTRON AND CAPTURE GAMMA-RAY DISTRIBUTIONS IN RECTANGULAR CONCRETE DUCTS. Maerker, R. E.; Cain, V. R. (Oak Ridge National Lab., Tenn.). Aug. 1967. Contract W-7405-eng-26. 125p. Dep. CFSTI.

This report describes the AMC code and is intended to serve as a reference manual to be used with the code. This code can be used to calculate the fluxes and dose rates inside large rectangular ducts constructed of concrete walls that arise from neutrons of all energies incident upon the duct mouth. An option in the code allows a simultaneous calculation of the secondary gamma-ray dose rates arising from wall capture as well. The code treats duct transmission by employing the albedo concept in conjunction with a Monte Carlo treatment of history generation. The present description is limited to six distinct types of rectangular duct geometries, but includes ducts having up to three legs with two right-angle bends. (auth)

35211 ENERGY FLUX OF GAMMA RADIATION FOR DEEP PENETRATION. Krueger, F. W. (VEB Kombinat Kernenergetik, Berlin). Kernenergie, 10: 147-9(May 1967). (In German).

For great distances from a monoenergetic gamma source the energy flux will be proportional to $e^{-\mu_0 z} z^{\varkappa_0} p$ where μ_0 is the absorption coefficient for the source photons and z the distance from the source. The parameter p is determined by the source geometry. The exponent $\varkappa_0$ depends on the energy of the source photons and on the material which the radiation penetrates. We have calculated $\varkappa_0$ for the elements H, Be, C, Na, Mg, Al, Si, Fe, Cu, Sn, W, Pb, U as well as for water. The results are given in a table. (auth)

Solid-State Physics

Refer also to abstract 34896.

35212 (AD-636163) RADIATION STUDY ON MOS STRUCTURES. Scientific Report No. 1, December 15, 1965-May 15, 1966. Snow, E. H.; Grove, A. S. (Fairchild Semiconductor, Mountain View, Calif.). June 1966. Contract AF19(628)-5747. 29p. (AFCRL-66-449). CFSTI.

Ionizing radiation causes the buildup of a positive space-charge

within the oxide on an MOS structure. The location of this space-charge and the kinetics of its formation and annealing have been studied experimentally. On the basis of these experiments, a simple model has been proposed, which relates this space-charge to the defect structure of the oxide and provides results in good agreement with the data. Photocurrents flowing in the oxide following irradiation by x rays and ultraviolet light have been used in the interpretation of the experiments and have made possible the construction of detailed energy band diagrams of the MOS structure. (auth)

35213 (BMwF-FBK-67-37) MESSUNG DER MAGNETISCHEN KLEINWINKELSTREUUNG THERMISCHER NEUTRONEN AN UNMAGNETISIERTEM EISEN. (Magnetic Small Angle Scattering of Thermal Neutrons in Unmagnetised Iron). Mathur, J. N. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). Apr. 1967. 26p. (In German). Dep.

When a well collimated beam of thermal neutrons is passed through samples of unmagnetized iron, the beam is found to diverge in very small angles of the order of minutes. But as soon as the samples were slightly magnetized the broadening of the beam disappeared. The purpose of this work was to find out the cause of this broadening of the beam. The experimental results were compared with the two contradictory theories (refraction or diffraction) and it was found that for the domain size and the neutron wavelength under consideration, the cause of the small-angle scattering was refraction of neutrons at domain boundaries. (auth)

35214 (BMwF-FBK-67-50) UNTERSUCHUNGEN ZUM DURCHGANG POLARISIERTER NEUTRONEN DURCH AUFMAGNETISIERTE FERROMAGNETICA MIT EINER STERN–GERLACH-ANORDNUNG. (Measurements of Polarized Neutron Transmission Through Magnetized Ferromagnetic Materials by a STERN–GERLACH Experiment). Brand, K.; Nagib, M. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). June 1967. 9p. (In German). Dep.

A Stern–Gerlach experiment with slow monochromatic neutrons is described. A mechanical velocity selector served as monochromator. The inhomogeneous field of a Stern–Gerlach-type magnet was used to produce two neutron beams polarized in opposite directions. With these polarized neutrons transmission measurements were made with magnetized nickel and a ferrite alloy. These measurements at different magnetization of the samples give the law of the approach to magnetic saturation at high fields in form of a 1/H dependence. (auth)

35215 (COO-1112-115) HYDROSTATIC PRESSURE EFFECTS ON THE EPR SPECTRA OF DOPED SAPPHIRES. Herman, John Edward (Michigan Univ., Ann Arbor). 1966. Contract AT(11-1)-1112. 172p. Dep. CFSTI.

Thesis.

The interaction of the isoelectronic impurity ions V^{2+}, Cr^{3+}, and Mn^{4+} with the α-Al_2O_3 crystal lattice was studied by observing the hydrostatic pressure dependence of their electron paramagnetic resonance (EPR) spectra to 6000 atmospheres. A two-sample comparison method was used in which two identical samples were placed in the X-band microwave resonant cavity. One end of the cavity and one sample were subject to hydrostatic pressure. The changes in the spin Hamiltonian parameters were obtained by measuring the difference in the magnetic field required for the same resonance condition in each sample as a function of pressure. It is concluded that the ions occupy similar lattice sites and are subject to nearly the same compressibility. Comparison with both the crystal field model and the molecular orbital model revealed that the predictions of both models for the pressure dependence were consistent and yielded a pressure dependence of the spin-orbit coupling constant λ of $\Delta\lambda/\lambda = (1.7 \pm 0.2) \times 10^{-3}$/katm. This change in λ as a function of pressure may be explained within the framework of the crystalline field theory by a contraction of the 3d wave functions, and within the framework of the molecular orbital theory by an increase in covalency. Overall consistency was maintained only by assuming the compression is approximately conformal and that the compressibility is about four times the bulk compressibility. (auth)

35216 (COO-1112-116) SEARCH FOR THE MAGNETIC FIELD INDUCED OPTICAL SECOND HARMONIC. Phillips, Richard Arlan (Michigan Univ., Ann Arbor). 1966. Contract AT(11-1)-1112. 86p. Dep. CFSTI.

Thesis.

A search is reported for an as yet undiscovered nonlinear optical effect, the magnetic-field-induced second-harmonic generation. This effect can be described by a tensor relationship between the induced polarization and the applied fields: $P_n^{2\omega} = X_{ijklm}\,\epsilon_{jkm} B_a^0 E_l^\omega E_m^\omega$, where P, B, and E refer to the polarization, magnetic fields, and electric fields respectively. The superscripts serve to identify the relevant frequencies, the subscripts denote cartesian components, and ϵ_{jkn} is a permutation tensor required to preserve the spatial transformation properties of the magnetic field. Theoretical and empirical considerations suggest that the expected values of the tensor coefficients are bracketed between 10^{-16} and 10^{-19} esu. Experiments designed to detect magnetic-field-induced second-harmonic radiation were accomplished with quartz and ADP. Since no magnetic-field-induced signals were observed, upper limits can be set for some of these materials. For quartz, X_{zxyu} was found to be less than 3×10^{-19} esu with an estimated uncertainty of fifty percent. For ADP the ratio of X_{xyzm} to X_{xyz}, the coefficient of normal second harmonic generation, was found to be less than 5.2×10^{-10} esu, with an estimated uncertainty of seventy percent. Accepting the value of X_{xyz} in ADP of 1.4×10^{-9} esu, X_{xyzm} was found to be less than 7×10^{-19} esu, with an estimated uncertainty of approximately seventy percent. Many other materials were considered and it was decided to perform experiments with nickel sulfate, nickel selenate, and paraglass. All yielded negative results. (auth)

35217 (COO-1198-443) THE SCIENCE OF MATERIALS. Annual Progress Report. (Illinois Univ., Urbana. Materials Research Lab.). Apr. 15, 1967. Contract AT(11-1)-1198. 76p. Dep. CFSTI.

The object of the work, results obtained during fiscal year 1967, and the results expected in 1968 and 1969 are summarized for the following projects: solid state transformations, electronic band structure of alloys of transition metals, point defect–dislocation interactions, conduction mechanisms in semiconducting glasses, mechanical and surface behavior of crystals, first-order phase transformations in crystalline solids, annealing of cold-worked metals, nuclear magnetic resonance studies, electronic structure of alloys, magneto-optic absorption by R centers in the alkali halides, use of very high pressure to study the structure of matter, anharmonic effects in solids, defect and electronic properties of solids, properties of noble gas crystals, magnetic resonance in solids, properties of materials at very low temperatures, mechanical behavior and corrosion of coated and composite materials, and effects of high-energy-particle irradiation on properties of solids. No detailed data are included; publications are listed. (A.G.W.)

35218 (COO-1198-453) MAGNETIC SUSCEPTIBILITY AND KNIGHT SHIFT MEASUREMENTS IN ALUMINUM-RARE EARTH ALLOYS. Stupian, Gary Wendell (Illinois Univ., Urbana). June 1967. Contract AT(11-1)-1198. 125p. Dep. CFSTI.

Measurements of magnetic susceptibility and solvent Knight shift in dilute alloys of rare earth metals in aluminum were carried out. The susceptibility results give a clear indication that localized moments exist on each impurity except La, Yb, and Lu, and that the coupling between the total spin and the total orbital angular momentum of f electrons is dominant in determining the size of localized moments on solutes. The maximum magnitude of localized moments observed was over 10 μ_B, which is impossible without a contribution to the magnetic moment from orbital angular momentum. The susceptibility also shows the deviation from Curie law behavior resulting from the population of excited states. The solvent Knight shift permitted a particularly penetrating investigation of solute structure because it is influenced only by the polarization of electron spins. The observations show conclusively that the spin magnetization opposes the total impurity magnetization in lighter rare earths while aiding it in heavier rare earths. A quantitative discussion, using scattering theory, of the electron polarization caused by magnetic impurities was found to give a satisfactory account of observed Knight shift changes. The magnitude and sense of the shifts are reproduced satisfactorily by the assumptions that the localized states are about 0.6 eV wide and that, for heavier elements containing electrons in both spinup and spindown subbands are separated by about 1 eV. A qualitative explanation of the observed NMR solvent line width for the various solutes is given. (auth)

35219 (IS-T-170) AMPLITUDE STUDIES OF THE DE HAAS–VAN ALPHEN EFFECT IN LEAD. Phillips, Russell Allan (Ames Lab., Iowa). May 1967. Contract W-7405-eng-82. 135p. Dep. CFSTI.

Thesis.

A detailed study of the amplitudes of the de Haas–van Alphen (dHvA) effect in lead is presented. These experiments were performed in a high-field pulse magnet employing a resonant filtering system. As a prelude to this work, it was necessary to devise special techniques for the preparation of crystals of high perfection. Accurate effective mass values were measured for all the dHvA frequencies at symmetry directions. These mass studies refer not only to the fundamental terms but also to higher harmonics and combination tones. The results of the temperature-dependence of the harmonic and combination amplitudes indicate that magnetic-interaction effects must be considered. By a generalization of Shoenberg's original approach to the magnetic-interaction problem, many of the observed features of the har-

monic and combination amplitudes have been accounted for. Extensive studies of the magnetic-field dependence of the dHvA amplitudes were also made. The results of these measurements show that the Landau levels in pure lead crystals of high perfection are indeed very sharp. (auth)

35220 (N-67-20254) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THE PHYSICS OF CRYSTALLINE SURFACES. Annual Report, February 1, 1966–January 31, 1967. Bauer, E. (Naval Ordnance Test Station, China Lake, Calif.). 68p. (NASA-CR-82855). CFSTI.

In studies of the physics of crystalline surfaces the following topics are considered: (1) the relation between structure of epitaxial films and surface and interfacial energies; (2) elastic and inelastic interactions of slow electrons with tungsten single crystal surfaces; (3) determination of nature and structure of surface layers with low energy electron diffraction; (4) the relation between structure and electron-emission properties of work function reducing layers on tungsten planes; (5) momentum exchange of atoms on well defined single crystal surfaces; and (6) the theory of low-energy electron scattering. Next, it is illustrated that superstructure patterns can be interpreted in terms of double scattering between structures well known from bulk crystal structure analysis, involving only minor lattice distortions of the surface layers. Finally, the subject of linear unfolding methods and optimization for x-ray and similar spectra is considered. The importance of optimization is demonstrated on the basis of comparative accuracy considerations, including both variance and expectation value of solutions. (STAR)

35221 (NP-16782) OB ENERGETICHESKOM SPEKTRE ELEKTRONA V "ISPORCHENNOI" ODNOMERNOI PERIODICHESKOI RESHETKE. (Energy Spectrum of an Electron in a Distorted, One-Dimensional, Periodic Lattice). Preprint No. 13. Zaslavskii, G. M.; Sardeev, R. Z. ' (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). 1966. 10p. (In Russian). Dep.

One of the most timely applications of the method for determining the density distribution of energy levels of disordered systems relates to the problem of determining the energy spectrum of the electron in a "distorted" lattice or amorphous disordered systems. Difficulties are encountered in the determination of the spectral density near the edge of the permitted energy ranges because in that case even an extremely low level of disorder affects strongly the nature of the spectrum. In order to avoid this difficulty, models were developed to find an asymptotic solution for the spectral density. Such a one-dimensional, distorted lattice model was examined, considering the case, in which the potential contains regular periodic additives. If the additives follow a Poisson distribution, they are not located at the junction points of the lattice and the edge of the permitted zone will be shifted. (TTT)

35222 (NYO-3464-07) F CENTER IN CESIUM FLUORIDE. Report No. 699. Fulton, Theodore Alan (Cornell Univ., Ithaca, N. Y. Materials Science Center). Sept. 1967. Contract AT(30-1)-3464. 292p. Dep. CFSTI.

Thesis.

A number of properties of the F center in cesium fluoride were investigated. These include the optical absorption F band lineshape and its temperature, magnetic field and stress dependence, and the photoconductivity, luminescence, and ground-state repopulation behavior. The F band possesses a well-resolved triplet structure. The magnetic circular dichroism measurements show that the P-states are split by a large spin-orbit coupling. The coupling of the center to cubic modes of vibration is relatively weak and the coupling to noncubic modes of vibration relatively strong, their contributions to the second moment of the F band being in the ratio of one to four. The high-energy F-band component is due to transitions to the P_4 state and the other two components to transitions to the P_5 state. The latter is split by a dynamic Jahn–Teller effect, as suggested by Moran. The temperature- and stress-induced behavior is consistent with this model. An unusual feature in the F-band lineshape is the presence of structure due to optical transitions in which zero, one or more optical phonons of cubic symmetry are created. The photoconductivity and certain optical bleaching experiments show that the lattice relaxation processes which follow the absorption of a photon depend upon whether the electron is excited to the P_4 or P_5 state. For P_4 excitation the electron reaches an intermediate metastable "relaxed" state before decaying to the lowest relaxed excited state. Luminescence and ground-state repopulation measurements have revealed an unusual discrepancy between the luminescence lifetime, 50 nsec., and the time required for the electron to return to its ground state after excitation, 1 μsec. The bottleneck is in the return to the ground state after the emission and is of unknown origin. Because of this behavior the interpretation of the luminescence behavior is somewhat tentative. If the effect is intrinsic to the F center then the luminescence experiments suggest that the usual picture of a highly diffuse relaxed excited state does not apply to the F center in cesium fluoride. (auth)

35223 (UCRL-70240) SHOCK-INDUCED DEMAGNETIZATION OF NICKEL FERRITE, YTTRIUM IRON GARNET, AND IRON. Royce, E. B. (California Univ., Berkeley. Lawrence Radiation Lab.). June 1, 1967. Contract W-7405-eng-48. 17p. (CONF-670914-4). Dep. CFSTI.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

The demagnetization of samples of nickel ferrite, yttrium iron garnet, and iron on shock compression has been measured as a function of pressure and biasing field. In low-field experiments, the shock-induced reduction in magnetic flux through the sample was detected by pickup coils wound on ferrite bars completing the magnetic circuit between the sample and biasing permanent magnet. In high-field experiments, a pulsed solenoid was used to bias the sample. The magnetization was always biased in a direction transverse to the shock-propagation direction, and only the change in the transverse component was measured. For the ferrimagnetic ceramics nickel ferrite and yttrium iron garnet, the change in magnetization is due to the combined effects of (A) the shift in Néel temperature with compression and the temperature rise associated with shock compression, and (B) a shock-induced longitudinal magnetic anisotropy associated with the shock-induced anisotropic microscopic strain. This anisotropy originates from the nonzero yield strength of the material and results in the shock-propagation direction becoming an easy direction of magnetization. At bias fields of 300 and 900 Oe, the rotation of the direction of magnetization resulting from this anisotropy produces almost complete transverse demagnetization in nickel ferrite. At a bias field of 110 kOe, the induced anisotropy is overcome, and the true demagnetization is measured. The results are not inconsistent with the Néel point shift deduced from static high-pressure experiments. In yttrium iron garnet, the induced anisotropy is weaker and was studied by varying the bias field near 300 Oe. For ferromagnetic iron, the demagnetization is due to the polymorphic phase transition at 130 kbar, complete demagnetization being observed above that pressure. From the decay of the demagnetization pulse, the electrical conductivity of iron at high pressure is estimated. (auth)

35224 (ANL-Trans-496) MEASUREMENT OF DECAY PERIODS OF THE LUMINESCENCE DURING THE EXCITATION BY ELECTRONS. Hanle, W.; Jansen, H. G. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Z. Naturforsch., 9A: 791-7(1954). 15p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

The phase-tube method for the measurement of the decay periods of the luminescence during excitation by electrons reported by Rohde has been improved with respect to the light intensity and measuring accuracy and transformed further into an absolute method. Anthracene and other organic substances exhibit a dependence of the decay time on the grain size, purity, and excitation conditions (electrons or x rays). The mechanism of the energy transfer in liquid and solid mixed systems has been investigated for a number of examples. It was found for anthracene in naphthalene and for anthracene in liquid solutions, that at low concentrations of the dissolved substance the energy transfer is not nonradiative but occurs by absorption and reemission. The response of the measuring apparatus during two or several radiation processes in particular during the appearance of the secondary fluorescence is discussed and it is shown that here the calculation of decay times from the measured phase angles is subject to considerable limitations. (auth)

35225 (ANL-Trans-499) MEASUREMENTS OF THE DECAY PERIODS OF LUMINESCENCE BY MEANS OF THE PHASE TUBE. Rohde, Friedrich. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Z. Naturforsch., 8A: 156-61(1953). 11p. Dep. CFSTI. JCL $1.60 fs, $0.80 mf.

A new method has been developed for the measurement of decay times. The luminescence is excited by electrons whose intensity is high-frequency-modulated. The luminescence is recorded by a secondary electron amplifier. There exists a phase shifting between the modulations of the exciting electron current and of the luminescent light. The phase difference of the modulation of the luminescence of different substances against a standard substance is measured with a phase detector tube and the decay time difference calculated therefrom. Organic compounds and polystyrene foils with embedded dyes and the applicability of foils as grainless luminescent screens for cathode rays were studied. A decrease of the decay time with the irradiation time was observed for some compounds. (auth)

35226 MEASUREMENTS OF DISLOCATION DAMPING IN NEUTRON-IRRADIATED SILVER. Queen, T. J. (Univ. of Strathclyde, Glasgow). Phys. Lett., 25A: 25-6(July 17, 1967).

A decrease in the logarithmic decrement of neutron-irradiated high-purity silver was observed upon isochronal annealing, centered around 60°C, for which it is thought that vacancies are responsible. The release of defects from dislocations was observed to occur between 200° and 300°C. (auth)

35227 EFFECTS OF CHANNELING ON THE EFFICIENCY OF ANTHRACENE BOMBARDED BY α PARTICLES. Wick, K.; Flammersfeld, A. (Univ., Goettingen, Ger.). Z. Phys., 204: 164-72(1967). (In German).

The scintillation response of anthracene crystals to α particles was investigated as a function of angle of incidence with respect to the crystal axes. Small local minima of the scintillation response occurred, when the α particles were incident along the directions c, [102], [111], [1$\bar{1}$1], [$\bar{1}$11], [$\bar{1}\bar{1}$1], [121], [1$\bar{2}$1] and along the bc and ($\bar{2}$01) plane. In naphthalene and terphenyl similar minima could not be traced. The observed effects are interpreted as channeling effects. (auth)

35228 AMORPHIZATION OF POLYCRYSTALLINE GERMANIUM FILMS ON IRRADIATION WITH ARGON IONS. Pavlov, P. V.; Tetel'baum, D. I.; Zorin, E. I.; Kudryavtseva, R. V. (Gorky Scientific-Research Physical-Technical Inst., USSR). Sov. Phys.-Cryst. (Engl. Transl.), 12: 134-6(July-Aug. 1967).

Translated from Kristallogr., Akad. Nauk SSR, 12: 155-7(Jan.-Feb. 1967).

Bombardment with 500-keV argon ions was carried out in an accelerator with a magnetic analyzer. The ion current density was 2 to 4 μA/cm^2. The irradiation doses were 1, 10, 100, 1000, and 5000 μCi/cm^2. The vacuum in the target chamber was 2.10^{-4} mm Hg. The samples were heated to 90°C during the bombardment in order to reduce the absorption of organic vapors. (W.D.M.)

35229 STRUCTURE OF URANIUM IN THIN FILMS. Kolomiets, L. D. (Physical-Technical Inst., Kharkov). Sov. Phys.-Cryst. (Engl. Transl.), 12: 132-3(July-Aug. 1967).

Translated from Kristallogr., Akad. Nauk SSR, 12: 154-5(Jan.-Feb. 1967).

An attempt was made to produce β-phase uranium in thin films condensed under vacuum conditions. Films were obtained by evaporating the 99.82%-pure metal from a tungsten spiral onto rock-salt crystal cleavages, or quartz and carbon films deposited on copper grids. After emerging from the vacuum chamber, the films oxidized in air at room temperature. No trace of the tetragonal β phase was found in thin uranium films deposited on various substrates in a vacuum of 10^{-4} to 10^{-5} mm Hg. (W.D.M.)

35230 RADIATION DAMAGE IN ALKALI AND SILVER HALIDES. Waidelich, W. (Technische Hochschule, Darmstadt, Ger.). Photogr. Sci. Eng., 11: 167-72(May-June 1967).

Radiation damage in alkali and silver halides is studied by measuring the optical absorption and the change of lattice parameter and mass density. Reciprocity curves can be obtained by measuring the change of the mass density. (auth)

35231 ENTROPY PRODUCTION IN THE CASE OF DYNAMIC POLARIZATION OF NUCLEI BY THE SOLID EFFECT. Constantinescu, Florin; Militaru, Valentin. Stud. Univ. Babes-Bolyai, Ser. Math.-Phys., 11: No. 2, 121-9(1966). (In Rumanian).

A study was made to establish the physical conditions under which the thermodynamic principle of the entropy minimum production is applicable to irreversible stationary processes of dynamic polarization of the nuclei by the solid state effect. The method used is based only on stochastic equations of the process and does not use the spin temperature concept whose validity is assured only for particular cases. The results obtained show that in a stationary state, not far from equilibrium, the principle of the entropy production minimum is valid in the usual experimental conditions for observation of the solid state effect. (tr-auth)

35232 MOESSBAUER EFFECT AND ITS APPLICATION IN SOLID-STATE RESEARCH. van Wieringen, J. S. (Philips Research Labs., Eindhoven, Netherlands). Philips Tech. Rev., 28: 33-43(1967).

The Moessbauer effect is illustrated for the case of iron nuclei in three magnetic materials: "Ticonal" alloys and the ferrimagnetic oxide materials $NiFe_2O_4$ and ferroxdure. In "Ticonal" the iron in the alloy was found to be partly in a ferromagnetic and partly in a paramagnetic environment. From this, and from the results of electron-microscopic investigations, an explanation is found for the high coercivity of this material. In $NiFe_2O_4$ the magnetization of the two iron sub-lattices was determined separately. In ferroxdure the same was done for all five sub-lattices over which the iron is distributed in this compound. (auth)

35233 INTRINSIC EFFICIENCIES AND RADIATION DAMAGE IN POLYCRYSTALLINE PHOSPHORS IRRADIATED WITH HIGH ENERGY ELECTRONS. Belcher, Ralph Leon. College Park, Md., Univ. of Maryland, 1966. 138p.

Thesis.

The intrinsic efficiencies for the conversion of electron beam power into radiant power by powdered CdS:Ag and ZnS:Cu phosphors were measured. The phosphors were excited with monoenergetic electrons and the irradiance on a fast thermopile with a uniform spectral response was determined. The measurements were made with the aluminum-backed phosphors located inside the evacuated beam tube of a PS-400 Van de Graaff accelerator. Using Berger's calculation for the deposition of energy as a function of depth in target, the Kubelka–Munk equation for the transmission of light from various layers of the phosphor, and measured values for the reflectance of an infinite thickness of phosphor for its own light, a computer program was devised to calculate the efficiencies of the two phosphors. The efficiencies of CdS:Ag were determined at thicknesses ranging from 6 to 174 mg/cm^2 at electron beam energies of 100, 200, and 400 keV and found to be 12, 12, and 7%, respectively. For ZnS:Cu, electron energies of 200 and 400 keV were used with sample thicknesses up to 101 mg/cm^2. The efficiency at 200 keV was 21%. At 400 keV the efficiency for the thickest sample measured, 39 mg/cm^2, was found to be 20%. These efficiencies apply to conditions prior to radiation damage. Approximate values of the scattering and absorption coefficients of the two phosphors were also calculated from measurements of the reflectance of each phosphor for its own light. The scattering coefficient for CdS:Ag (mean diameter, 10.5 ± 1.0 μ) was found to be 0.05 cm^2/mg and the absorption coefficient was 4×10^{-5} cm^2/mg. For ZnS:Cu (mean dia. ~5 μ) a value of 0.015 cm^2/mg was calculated for the scattering coefficient and 3×10^{-4} cm^2/mg for the absorption coefficient. The decrease in radiant emittance of the CdS:Ag phosphor irradiated with 90-, 100-, 200-, and 400-keV electrons was determined as a function of the total energy absorbed by the phosphor. A surface darkening of the phosphor was observed at all electron beam energies, and significantly at 90 and 100 keV which are below reasonable estimates of the threshold energy for atomic dislocations. This darkening, which is attributed to radiation induced oxidation–reduction reactions, increased with total energy absorbed by the phosphor. The radiant emittance can be expressed by the empirical expression $W = W_0(1 + CN)^{-1}$ where N is the energy absorbed in rads and C is a constant. The radiant emittance appeared to decrease with increasing beam tube pressure. A method was developed for the precise measurement of the kinetic energy of an intense monoenergetic beam of electrons. It was applied to the calibration of the console voltmeter of the 400-keV accelerator. In this procedure the intensity of the electron beam is reduced to a sufficiently low value by elastic scatter from a thin aluminum foil so that the electrons can be directed onto a semiconductor detector without producing pulse pile-up effects. The electron energy is then determined from the elastic backscatter peak observed with a multichannel analyzer. The estimated error in the electron energy is 3.5 keV, the width of one channel on the analyzer. This corresponds to a 1% error at 400 keV and to a 4% error at 100 keV. This method is compared with and found to be superior to the more conventional ways of determining electron beam energies. (Disser. Abstr.)

35234 PHONONS IN PERFECT LATTICES AND IN LATTICES WITH POINT IMPERFECTIONS. Stevenson, R. W. H. Scottish Universities' Summer School, 1965. New York, Plenum Press, 1966. 461p. $22.50.

This volume contains the papers presented at the Scottish Universities' Summer School in Physics, 1965. After a general introduction, the papers are divided into two main subjects. In the first part, vibrations in perfect lattices are covered in terms of theory of phonon dispersion curves, phonons in metals, neutron scattering by phonons, x-ray scattering by phonons, anharmonic interactions, infrared lattice vibration spectra, Raman spectroscopy using a gas laser, Raman scattering by phonons, and amplification of lattice waves and related acousto–electric effects in semiconductors. In the second part, vibrations in lattices with point imperfections are considered in terms of experimental spectroscopy, electric states and spectra of ions and imperfections in solids, vibrations of defects in lattices, and interaction of lattice vibrations with electrons at point defects. (W.D.M.)

Theoretical Physics

Refer also to abstract 34995.

35235 (NYO-1480-74) SPACE–TEMPERATURE CORRELATIONS IN QUANTUM STATISTICAL MECHANICS. Kunkin, William; Percus, Jerome K. (New York Univ., N. Y. AEC Computing and Applied Mathematics Center). June 1967. Contract AT(30-1)-1480. 79p. Dep. CFSTI.

Some approaches used in classical statistical mechanics for

deriving integral equations for the pair distribution function are generalized to quantum systems. In the functional differentiation method, distributions depending on space and temperature arguments are generated from the grand partition function in external field. These distributions are diagonal elements of Green's functions and represent physical quantities when temperature arguments are set equal. A given distribution can be expanded in the external field by means of a functional Taylor series. An integral equation results when the external field is specialized to one arising from a number of fixed particles via their pair interaction with the remaining particles. In this case a distribution in external field may be converted to a higher order distribution for a uniform system. This process is accomplished by using a Feynman path integral representation for all quantities. Classical and quantum statistics are treated. In the former case the problem of bounds on distributions is also investigated. An alternate approach, the potential ensemble method, applies to Debye–Hückel sequences. Here one, e.g., replaces the actual density (with a particle fixed) by one in which a pair interaction of particles is replaced by an external field, but an ensemble average must be taken over all external fields. A steepest descent calculation enables one to find the pair distribution and best external field self-consistently. The quantum formulation of this method requires all quantities to be expressed on a lattice in occupation representation, in which a lattice site is specified by position in space, temperature, and particle number. Agreement between the two methods described here is indicated. (auth)

35236 (NYO–1480-75) THE ONE-BODY WIGNER–MOYAL DENSITY FOR A LOCALLY LINEAR POTENTIAL OF ARBITRARY DIMENSION. Percus, Jerome K.; Snygg, John (New York Univ., N. Y. AEC Computing and Applied Mathematics Center). June 1967. Contract AT(30-1)-1480. 10 3p. Dep. CFSTI.

Using the Wigner–Moyal density and operator techniques, WKB like solutions are obtained in closed form for a system of noninteracting particles in an arbitrary potential of arbitrary dimension. For three dimensions the first three terms of the asymptotic expansion give the Thomas–Fermi approximation with the Weizsäcker correction reduced by ⅓ plus an oscillatory term of amplitude 6 times the reduced Weizsäcker correction. For one dimension the first two terms correspond to a result of Kohn and Sham. (auth)

35237 SCHWARZSCHILD'S CRITERION FOR CONVECTIVE INSTABILITY IN GENERAL RELATIVITY. Kovetz, Attay (Tel-Aviv Univ., Israel). Z. Astrophys., 66: 446-56(1967).

It is possible to formulate, for a system in general-relativistic hydrostatic equilibrium, a buoyancy principle which is a generalization of Archimedes' principle. A consequence of this principle is the following criterion for convective instability: a fluid mass in static equilibrium in a gravitational field is stable with respect to motions in which the thermodynamic quantity χ is conserved if, and only if, $dp/de < (\partial p/\partial e)_\chi$. Here p and e are the proper pressure and energy density, respectively; dp/de is the rate of increase of p with e in the equilibrium configuration, while $(\partial p/\partial e)_\chi$ is the corresponding derivate taken at constant χ. The criterion is the general-relativistic extension of the classical Schwarzschild criterion. The proof is carried out under the assumption that the prevailing gravitational field is unaffected by small perturbations of the equilibrium, and is based on the solution of the initial value problem for the general-relativistic hydrodynamical perturbation equations. It is also shown that, in any hydrostatic configuration, the proper pressure and energy density must both decrease outwards. (auth)

35238 ELECTROMAGNETIC WAVES IN THE GENERAL RELATIVITY. Maldybaeva, E. Ya. (Physical-Technical Inst., Dushanbe, USSR). Dokl. Akad. Nauk SSSR, 172: 320-1(Jan. 11, 1967). (In Russian).

The electromagnetic field F in the hyperbolic Riemann manifold may be characterized by means of external differential forms; in that case, the Maxwell equation in vacuum, in the absence of charged particles, may be represented as $dF = 0$, $\delta F = 0$, whereby d is the external differentiation operator and δ is the operator of codifferentiation of forms. Thus, the second form of F is harmonic, satisfying the generalized wave equation $\Box F = 0$, whereby $\Box = d\delta + \delta d$, represents the d'Alembert operator of the Riemann manifold. In a curved space–time system, assuming that the $T \times V_3$ derivative possesses a topological structure, a series of second order equations was obtained for the electromagnetic field equation system. It was found that the electromagnetic wave flux does not conserve its form, as the Huygens principle is not fulfilled. An attempt was made to determine the structure of a curved space–time system in which the electromagnetic waves propagate without forming a tail-end system. The calculations indicated that the conforming curvature tensor must belong to the second degenerate or the third type, as classified by A. Z. Petrov, or it must be zero. The latter case corresponds to a conforming Euclidean space. (TTT)

35239 VARIATIONAL DEDUCTION OF SPINOR FIELD EQUATIONS. Brinis, Elisa Udeschini (Univ., Milan). Meccanica, 2: No. 1, 11-18(Mar. 1967).

A first-rank spinor is shown to be expressible by means of the spinor derivatives of a potential spinor. It is then possible, when considering a space–time field characterized by a pair of first-rank spinors and by the respective complex conjugates, to deduce all field equations from a variational principle, by working an arbitrary variation on the potential spinors and on the respective conjugates. Appropriately particularizing the Lagrangian density, Dirac equations for particles of spin ½ are derived. Some results obtained, in a recent work, for second-rank symmetric spinors are so extended to the first-rank spinors. (auth)

35240 INTEGRABILITY CONDITIONS OF THE EQUATIONS FOR EINSTEINIAN GRAVITATIONAL FIELDS. Venini, Carlo (Univ., Milan). Meccanica, 2: No. 1, 19-24(Mar. 1967).

Within the terms of the Einsteinian general theory of relativity is studied the behavior of a material particle with a mass that is not too great in comparison with the total mass of the bodies which generate the field to which the particle itself is subject. The integration of the gravitational equations implies that the corpuscle is rigidly connected with a particular reference system of Fermi type, which is coordinated with the time line of the corpuscle itself. (auth)

35241 INTRINSIC PROBLEM OF EVOLUTION OF EINSTEIN EQUATIONS. Caricato, Gaetano (Consiglio Nazionale delle Ricerche, Rome). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 41: 487-93(Dec. 1966). (In Italian).

The restricted problem of evolution for the vacuum Einstein equations in invariant form is considered. Taking into account previous results of A. Lichnerowicz and Y. Bruhat, without any assumption of analyticity, a theorem of existence and unicity is established. (auth)

35242 SCHWARZSCHILD SPACE IN SYNCHRONIZED COORDINATES. von Borzeszkowski, H. H. (Institut fuer Reine Mathematik, Berlin). Ann. Phys. (7), 19: 312-14(1967). (In German).

The problem of constructing synchronized coordinate systems in which Schwarzschild singularities can be obtained simultaneously, and which are consistent with Einstein's vacuum field equations, is treated. (L.B.S.)

35243 GENERAL FLUCTUATION THEOREMS OF QUANTUM STATISTICS. Terletskii, Ya. P.; Tang, Nguyen (Moscow State Univ.). Ann. Phys. (7), 19: 299-311(1967).

The general theorems of classical statistical mechanics used to calculate the fluctuations and the correlations are generalized to the case of quantum systems. The exact relations of quantum statistics are obtained and they permit to calculate the time correlations in theory of Brownian motion without supplementary assumptions about character of the correlations of chance forces. From these relations the generalized reciprocal Onsager relations and the generalized fluctuation–dissipation theorem are found, as the exact theorems of nonequilibrium quantum statistics. (auth)

35244 FRIEDMANN REGION IN VACUO. Murai, Yasuhisa (Saitama Univ., Urawa, Japan). Progr. Theor. Phys. (Kyoto), 37: 761-2(Apr. 1967).

Solutions of Einstein's equation for the Friedmann region are investigated, using the external and internal boundary conditions. (M.O.W.)

35245 FIELD THEORETICAL METHODS IN MANY-BODY SYSTEMS. Kirzhnits, D. A. International Series of Monographs in Natural Philosophy, Vol. 8. Oxford, Pergamon Press, 1967. 394p. £ 5, 10s.

Translation by A. J. Meadows of Polevye Metody Teorii Mnogikh Chastits.

The subject is treated under the following main headings: Introduction—Essential quantum mechanical data–Many-body systems in the Hartree-Fock approximation–Perturbation theory and diagram technique–Method of Green functions in quantum mechanics–Method of Green functions in quantum statistics. (UK)

35246 THE STUDY OF THE ROLE OF THE GRAVITATIONAL FIELD IN QUANTUM FIELD THEORIES AND OF SOME PROPERTIES OF A DIRAC PARTICLE IN A GRAVITATIONAL FIELD. Garber, Vitalij. University, Ala., Univ. of Alabama, 1966. 73p.

Thesis.

The role of the gravitational field in quantum field theories was investigated by requiring the quantum field theory to be generally

covariant under the generalized inhomogeneous Lorentz group of transformations $x'^{\mu} = a^{\mu}{}_{\nu}(x)x^{\nu} + b^{\mu}(x)$. By assuming covariance of the matter field under this group, using the concept of local measurement, and working in the Lagrangian formalism, it is shown that the usual gravitational field variables (in vierbein form) arise as c-number quantities if the equivalence principle is invoked. Further arguments for the c-number gravitational field are given, and the relationship of the gravitational field to quantum fields indicated. Starting from the variational principle, the modified Klein–Gordon and Dirac equations are derived. Conservation laws and identities in the presence of Fermion fields are developed. Finally, the vierbein and local affine-connection variables for the linear acceleration and Schwarzschild fields are obtained. The Dirac equation for this spherically symmetric gravitational field is separated into angular and radial parts, and radial equations are obtained. Power series solutions of the equations are attempted, and it is found that a large number of conditions must be satisfied if the series are to terminate. While the interpretation of this result is not clear, it is conceivable that it either indicates the absence of bound states for the field or else the possibility of determining eigenvalues of other physical parameters besides the energy. (TSS) (Disser. Abstr.)

PHYSICS (HIGH ENERGY)

Particle Interactions and Properties (Experimental)

35247 (NP-16781, 9-19) HIGH ENERGY PHYSICS. (University Coll., London (England). Dept. of Physics).

The research programs of the bubble chamber, nuclear emulsion, nuclear physics, and spark chamber groups at University College, London, are briefly outlined. (B.G.D.)

35248 (NYO-2262TB-131) A RESEARCH PROGRAM IN EXPERIMENTAL HIGH-ENERGY PHYSICS. Progress Report. Shapiro, Anatole M. (Brown Univ., Providence, R. I. Dept. of Physics). June 1, 1967. Contract AT(30-1)-2262. 14p. Dep. CFSTI.

A review of the experimental program of the Department of Physics at Brown University during September 1, 1966–August 31, 1967. The review includes the AGS spark chamber experiment, the $\bar{p}$-p bubble chamber experiment, the Cosmotron spark chamber experiment, the Argonne bubble chamber experiment, the backward scattering AGS spark chamber experiment, the PDP-9 computer interface, geometric reconstruction computer programs, and Argonne beam designs. (B.G.D.)

35249 (TID-4005(Pt.6)(Rev.)) SUMMARIES OF RESEARCH IN HIGH ENERGY PHYSICS. (Division of Research (AEC), Washington, D. C.). July 1967. 150p. Dep. CFSTI.

Indexes prepared by Division of Technical Information Extension (AEC), Oak Ridge, Tenn.

Summaries of high energy physics research conducted at various laboratories and universities are presented. This revision includes a principal investigator index and a supplemented subject index. (J.F.P.)

Electromagnetic

35250 SEARCH FOR S = +1 BARYON STATES IN PHOTOPRODUCTION. Tyson, J.; Greenberg, J. S.; Hughes, V. W.; Lu, D. C.; Minehart, R. C.; Mori, S.; Rothberg, J. E. (Yale Univ., New Haven). Phys. Rev. Lett., 19: 255-9(July 31, 1967).

The photoproduction of negative mesons (K) on hydrogen was studied in a search for positive-strangeness baryon states. A missing-mass spectrometer was used in which the production angle and momentum of the meson (K^-) were measured. This experiment was performed using the bremsstrahlung beam produced using the electron accelerator. Some reactions which yield a negative meson (K^-) are listed, and in addition to these the final states may also include one or more mesons (π). A plot of the excitation function for the meson (K^-) yield against the missing mass is shown. (J.F.P.)

35251 K^0 PHOTOPRODUCTION CROSS SECTIONS COMPARED TO QUARK-MODEL PREDICTIONS. Roos, Charles E. (Vanderbilt Univ., Nashville); Mullins, Joe H.; Coyne, Donald G. Phys. Rev. Lett., 19: 261-3(July 31, 1967).

The upper limit of the ratio of K^0 production from the neutron to that from the proton at forward cm angles is determined experimentally. This limit is about 20 times less than the ratio predicted on the basis of quark wave functions, at the energies of this experiment. The maximum Q value for these reactions is 240 MeV, with forward three-momentum transfers in the range 260 to 390 MeV/c. (auth)

Weak

35252 (COO-1195-98) MEASUREMENT OF THE RELATIVE PARTIAL DECAY RATES FOR $K^\pm \to \pi^\pm\pi^+\pi^-$. Fletcher, Charles Roberts (Illinois Univ., Urbana. Dept. of Physics). 1967. Contract AT(11-1)-1195. 103p. Dep. CFSTI.

Thesis.

A spark chamber experiment was performed to measure the relative partial decay rates of positive and negative kaons decaying in the tau mode, $K^\pm \to \pi^\pm\pi^+\pi^-$. The ratio measured was $[\Gamma(--+)/\Gamma(++-)]$. The corrected value for the relative tau decay rates was $[\Gamma(--+)/\Gamma(++-)] = 1.005 \pm .009$. This result is consistent with four interpretations: There is no CP violation in $K^\pm \to (3\pi)^\pm$ as seen in the relative tau rates within the experimental error of 0.9%. There are no final state pion interactions. There is a negligible I = 3 contribution to the tau matrix element. There are weak final state pion interactions and a small I = 3 amplitude. (J.F.P.)

35253 (NEVIS-161) EXPERIMENTAL STUDY OF THE DECAY $K^+ \to \pi^0 e^+ \nu$. Garland, Robert W. (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). 1967. Contract AT(30-1)-1932. 118p. (CU-1932-265). Dep. CFSTI.

Thesis.

An experiment was performed using a magnet and spark chambers to study the decay $K^+ \to \pi^0 e^+ \nu$. Electrons were recognized by their shower production in $\frac{1}{4}$-in. aluminum plate spark chambers. On the basis of a spectrum of about 300 observed Ke3 events, it was concluded that the coupling form in the decay interaction is vector. The value found for the Ke3 branching ratio, R Ke3 = 0.045 ± 0.004, agrees with the prediction of the $\Delta I = \frac{1}{2}$ rule and K^0e3 data, and when combined with the $K\mu3$ branching ratio, also measured in this experiment, yields a value for the parameter $\xi = f_-/f^+$: $\xi = 1.3 \pm 0.5$. (auth)

35254 (NYO-2171-201) TIME DEPENDENCE OF K^0_{e3} DECAYS. Feldman, L.; Frankel, S.; Highland, V.; Sloan, T.; Van Dyck, O.; Wales, W.; Winston, R.; Wolfe, D. (Pennsylvania Univ., Philadelphia). May 1966. Contract AT(30-1)-2171. 11p. (CONF-660811-3). Dep. CFSTI.

From American Physical Society Meeting, Mexico City, Mexico.

An experiment was carried out at the BNL Cosmotron with a spark chamber in order to study the time dependence of K^0_e decays by the interaction $\pi^- + p \to \Lambda + K^0$. (B.G.D.)

35255 (PPAD-621F) ENERGY DEPENDENCE OF THE FORM FACTOR IN K^+_{e3} DECAY. Imlay, Richard L. (Princeton–Pennsylvania Accelerator, Princeton, N. J.). May 1967. Contract AT(30-1)-2137. 72p. Dep. CFSTI.

Thesis.

The decay $K^+ \to e^+ + \pi^0 + \nu$ was investigated in a spark chamber and counter experiment at the Princeton–Pennsylvania Accelerator. The K^+ mesons were stopped in a block of beryllium. A threshold gas Cherenkov counter was employed to select the positronic decay mode and the positron momentum was obtained with a series of thin plate spark chambers located in a magnetic field between the K^+ stopping region and the Cherenkov counter. The directions of the gamma rays from the π^0 decay were measured with a pair of lead plate spark chambers. A Dalitz plot of 1393 K^+_{e3} events agrees well with vector coupling. The π^0 energy spectrum was investigated to determine the energy dependence of the strong interaction form factor $f_+(q^2)$ where q^2 is the square of the four momentum transferred to the leptons and equals $M_e^2 + M_\pi^2 - 2M_kE_\pi$ for K^+ decays at rest. For a linear expansion $f_+(q^2) = f_+(0)(1 + \lambda\, q^2/M_\pi^2)$, we obtain $\lambda = 0.016 \pm 0.016$, which agrees well with previous measurements of λ for K^+_{e3}. Assuming the interaction is dominated by a $J = 1^-$, $I = \frac{1}{2}$ intermediate state of mass M, such as the K^* resonance at 890 MeV, we obtain $M = (1180^{+\infty}_{-381})$ MeV. This result is consistent with K^* dominance but also with no energy dependence for f_+. The value of λ for K^+_{e3} obtained in this experiment agrees with the weighted value $\langle \lambda^0 \rangle = 0.010 \pm 0.018$ obtained from four K^0_{e3} experiments and thus offers no evidence for violation of the leptonic $|\Delta I| = \frac{1}{2}$ rule. (auth)

35256 LEPTONIC K^0 DECAYS AND A TEST OF THE $\Delta S = \Delta Q$ RULE. Wolfe, David Morten. Philadelphia, Univ. of Pennsylvania, 1966. 110p.

Thesis.

A counter spark chamber experiment was done to test the predictions of the $\Delta S = \Delta Q$ rule in leptonic decays of the neutral K meson. A search was also made for possible CP violations in the decay. Kaons were produced in the reaction $\pi^- + p \to \Lambda + K^0$ using 1 BeV/c pi mesons incident on a liquid hydrogen target. An anticoincidence counter ensured the production of neutral products in the hydrogen, and a large, high pressure, gas filled Cherenkov counter ensured that one of the decay products was an electron. One hundred and sixteen kaon decays containing electrons were isolated and their lifetimes were measured. If f is the form factor for the reaction $K^0 \to \pi^- + e^+ + \nu$, which is allowed by the $\Delta S = \Delta Q$ rule, and g is the corresponding form factor for the $\Delta S = \Delta Q$ rule violating reaction $\bar{K}^0 \to \pi^- + e^+ + \nu$, the complex quantity $x = |x| e^{i\theta} = g/f$ may be defined. The data were analyzed by the maximum likelihood method, and $\mathrm{Re}(x) = 0.17^{+.11}_{-.11}$, $\mathrm{Im}(x) = 0.0^{+.3}_{-.3}$ was found. The results proved consistent with the validity of the $\Delta S = \Delta Q$ rule, while indicating no violation of CP invariance in the decay. In addition, comparison with known K^+ and K^0_l leptonic rates indicated consistency with the $|\Delta I| = \frac{1}{2}$ rule. (Disser. Abstr.)

35257 MUON PAIR PRODUCTION BY MUONS. Morris, Marvin Leon. Salt Lake City, Univ. of Utah, 1967. 61p.

Thesis.

A prototype of the University of Utah neutrino detector was successfully operated on the University of Utah campus from March

to August, 1966. The prototype demonstrated the feasibility of two types of detectors, cylindrical spark counters and large area directional Cherenkov detectors, along with their associated automatic handling system. The cylindrical spark counters were operated in a pulsed mode and triggered by the Cherenkov detectors. The prototype was used to observe muon pair production by cosmic ray muons. In a total running time of 837 hours, 33 events which are believed to be examples of symmetric muon pairs produced in the energy range 1 to 2 GeV were observed. During this time 2,060,000 cosmic ray muons traversed the prototype. The background from all sources is shown to be negligible. The observed cross section is shown to agree qualitatively with theory. Uncertainties in the detection efficiency of the prototype for small angle events prevented a more accurate comparison with theory. (TSS) (Disser. Abstr.)

Strong (Baryon-Induced)

Refer also to abstract 34491.

35258 (AD–650156) POLARIZATION PARAMETER IN ELASTIC PROTON–PROTON SCATTERING FROM 0.75 TO 2.84 GeV. Neal, Homer A.; Longo, Michael J. (Michigan Univ., Ann Arbor. Dept. of Physics). Mar. 1967. Contract Nonr-1224(23). 52p. (TR–27-03106-27-T; ORA–03106). CFSTI.

The polarization parameter in elastic proton–proton scattering was measured at 0.75, 1.03, 1.32, 1.63, 2.24, and 2.84 GeV by employing a double-scattering technique. An external proton beam was focused on a three-inch long liquid hydrogen target and the elastic recoil and scattered protons were detected in coincidence by scintillation counters. The polarization of the recoil beam was determined from the azimuthal asymmetry exhibited in its scattering from a carbon target. Values of the polarization parameter as a function of the center-of-mass scattering angle are given for each incident beam energy. The predictions of the Regge theory for polarization in elastic proton–proton scattering and recently published phase shift solutions are compared with the experimental results. Surprisingly good agreement with the Regge predictions is found despite the low energies involved. (auth) (TAB)

35259 LARGE-ANGLE $\bar{p}p$ ELASTIC SCATTERING AT 3.66 GeV/c. Katz, W. W.; Forman, B.; Ferbel, T. (Univ. of Rochester, N. Y.). Phys. Rev. Lett., 19: 265-7(July 31, 1967).

The $\bar{p}p$ elastic-scattering differential cross section shows a minimum at $t \sim 0.5$ $(GeV/c)^2$ and a secondary maximum at $t \sim 0.9$ $(GeV/c)^2$. The total cross section for the annihilation process $\bar{p} + p \rightarrow \pi^- + \pi^+$ is 6.6 ± 3.5 μb; the cross section for $\bar{p} + p \rightarrow K^- + K^+$ is <2.2 μb. (auth)

35260 PROTON–PROTON ELASTIC SCATTERING AND STRUCTURE WITHIN THE PROTON. Ratner, L. G. Argonne Nat. Lab. Rev., 33-7(Jan.-Apr. 1967).

The proton–proton elastic differential cross section was measured at 90° in the cm system as a function of the energy of the projectile proton. Fifty-one points were measured at momentum intervals of 100 or 200 MeV/c in the momentum range of 5.0 to 13.4 GeV/c. The cross sections obtained are plotted. Results seem to indicate that the proton itself exhibits a kind of shell-like structure. (J.F.P.)

Strong (Meson-Induced)

35261 (CEA-R-3105) ETUDE DE LA PRODUCTION ET DE LA DESINTEGRATION DU MESON η DANS LES INTERACTIONS π^+-DEUTERIUM ENTRE 600 ET 900 MeV. (Study of the η Meson Production and Decay in π^+d Interactions Between 600 and 900 MeV). Pauli, Eugene (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1967. 69p. (In French). Dep.

Thesis. Submitted to Univ., Strasbourg.

The reaction $\pi^+ + d \rightarrow p + p + \eta$ is observed in the 35 cm and 50 cm deuterium bubble chambers. A total of 150,000 pictures was taken at six incident energies of the π^+ between 600 and 900 MeV in a π^+ separated beam. The results of this study show that the η production cross section increases rapidly at threshold, then decreases slowly at higher energies. The η production angular distribution in the π^+-neutron cms is isotropic. From both of these facts, it is concluded that the η is produced in a S wave near threshold. As for the η decay, the values of the following branching ratios were determined: $\Gamma_\eta(\gamma\gamma)/\Gamma_\eta(\pi^0\pi^0\pi^0) = 1.1 \pm 0.5$. (auth)

35262 (COO-1112-103) DIFFERENCES BETWEEN π^+p AND π^-p ELASTIC SCATTERING IN THE DIFFRACTION PEAK REGION. Saulys, Alfred (Michigan Univ., Ann Arbor). 1966. Contract AT(11-1)-1112. 52p. Dep. CFSTI.

Thesis.

An experiment is described in which the elastic differential cross sections were measured for π^+p scattering at π incident momenta of 2.3 to 4.0 GeV/c and for π^-p scattering at 2.5 to 6.0 GeV/c. The experimental procedure in obtaining the data, the method of analysis, and the observed differences between π^+p and π^-p elastic differential cross sections are discussed. (B.G.D.)

35263 (COO-1112-106) π-p ELASTIC SCATTERING FROM 2.3 TO 6.0 GeV/c WITH SPECIAL REFERENCE TO THE BACKWARD DIRECTION. Williams, David Gerald (Michigan Univ., Ann Arbor). [1966]. Contract AT(11-1)-1112. 80p. DTIE.

Thesis.

Results are presented for 7 runs of π^+p elastic scattering with π momentum from 2.3 to 4.0 BeV/c, and for 5 runs of π^-p with momentum from 2.5 to 6.0. Differential cross sections were obtained for $\cos\theta = +.97$ to $-.94$. Experimental data were obtained with spark chambers, and a fully automatic scanning system was used in the analysis. The differential cross section in the region behind the two forward peaks is discussed. A calculation based on the formation of intermediate N* states is presented; it fits the data between the forward peaks and the backward peak fairly well. The backward peak may be calculable on the basis of exchange of Regge trajectories, plus N* formation. The cross section for $\pi^-p \rightarrow \bar{p}d$ at 6 BeV/c is found to be less than 9.1 μb. Slopes of the backward peaks are presented, as well as upper and lower bounds for $\pi^-p \rightarrow \pi^0 n$. (auth)

35264 (COO-1112-107) PION-NUCLEON ELASTIC SCATTERING IN THE BACKWARD HEMISPHERE AND THE APPLICATION OF REGGE THEORY TO BACKWARD ANGLES OTHER THAN COS THETA* equals −1. Dikmen, Fikri Ned (Michigan Univ., Ann Arbor). 1966. Contract AT(11-1)-1112. 80p. Dep. CFSTI.

Thesis.

The features and structure of the angular distributions in the meson (π)–nucleon elastic scattering process at 2.3 to 4.0 GeV/c for incoming mesons (π^+) and at 2.5 to 6.0 GeV/c for incoming mesons (π^-) are investigated. The secondary maximum, the backward peak, and the variation in their structure as a function of energy are studied. The results of Regge theory applied to backward scattering are also presented. (J.F.P.)

35265 (COO-1112-108) THE SECONDARY MAXIMUM IN PION–PROTON ELASTIC SCATTERING FROM 2.5 GeV/c TO 6.0 GeV/c. Ettlinger, Lester Andrew (Michigan Univ., Ann Arbor). 1966. Contract AT(11-1)-1112. 62p. Dep. CFSTI.

Thesis.

The differential cross section for elastic scattering of pions by protons between 2.5 and 6.0 GeV/c was measured in a spark chamber experiment at the Argonne ZGS. There is a secondary maximum in the differential cross section in the region $.6 < |t| < 2.8$ $(GeV/c)^2$, which decreases smoothly as a function of increasing beam momentum. For a given momentum of the incident pion, the scattering cross sections for π^+p and π^-p at the peak of the second maximum are equal, within statistical errors, in all cases. The pion-nucleon charge exchange cross section is seen to exhibit a secondary maximum at approximately the same value of t and is compared with the elastic scattering distributions. The effect of N* resonances on the elastic scattering distributions is discussed. (auth)

35266 (COO-1195-94) STRANGE PARTICLE PRODUCTION IN π^-p AND π^+n INTERACTIONS AT 2.5 GeV/c. Hanft, Raymond William (Illinois Univ., Urbana. Dept. of Physics). June 1967. Contract AT(11-1)-1195. 197p. Dep. CFSTI.

Thesis.

A bubble chamber experiment based upon 2.71×10^5 m π^- track length in hydrogen and 6.88×10^5 m π^+ track length in deuterium was performed to study strange particle production. Cross sections for π^-p reactions exhibit no marked departure from trends established by other experiments at nearby energies. In extracting information about π^+n interactions from the π^+D exposure it was found that 15 to 30% of events, depending on the final state particles, had protons with momentum greater than 250 MeV/c. These protons were not isotropic in the laboratory and therefore not spectators in the sense of the impulse approximation. Protons whose momentum lay in the interval 0 to 250 MeV/c were generally isotropic, and their momentum distribution agreed moderately well with a Hulthen distribution normalized over this interval. With the inclusion of the high proton momentum events the cross sections for processes apparently arising from π^+n interactions were found to be in satisfactory agreement with cross sections for the charge symmetric π^-p reactions. In the reaction $\pi^+n \rightarrow K_1^0(K^0)p$ evidence for weak φ production corresponding to about 10 μb cross section was obtained. No other enhancements in the $K\bar{K}$ or $K\bar{K}\pi$ systems were seen. $YK\pi$ and $YK\pi\pi$ states were found to be dominated by resonance production. However in $AK\pi$ states the $Y_1^*(1385)$, prominent at lower energies, was quite weak, thereby permitting measurement of the spin density matrix elements for $K^*(892)$ production in the AK^* state. The obtained value of $\rho_{33} = .45 \pm .08$ can be interpreted on the basis of the single particle

exchange model as indicating that vector (K*) exchange is somewhat more important than scalar (K) exchange. Similar results were obtained for the $\Sigma^0 K^*$ state. Although it was not clearly observed in $\pi^- p \rightarrow K^0(\Sigma\pi)^0$, a Y*(1660) was observed in $\pi^+ n \rightarrow K^+(\Sigma\pi)^0$. The appearance of this Y* in these data and its absence in data at higher energies indicates the excitation function for $\pi N \rightarrow KY^*(1660)$ is appreciable only in a small energy interval above threshold. (auth)

35267 (UCRL-17473) BISE: A TWO-VERTEX KINEMATIC PROGRAM. Hanerfeld, Harold (California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 28, 1967. Contract W-7405-eng-48. 31p. Dep. CFSTI.

BISE is a two-vertex kinematic least-square program written specifically for fitting events of the type

$$K^- + p \rightarrow \Sigma^+ + \pi^- + \pi^0$$
$$\qquad\qquad \lfloor\, p + \pi^0 \text{ or } \pi^+ + n$$

and

$$K^- + p \rightarrow \Sigma^+ + \pi^-$$
$$\qquad\qquad \lfloor\, p + \pi^0 \text{ or } \pi^+ + n$$

A complete description of the mathematical formulation on which the program is based is presented. (auth)

35268 NEW STRUCTURES IN THE K^+-p AND K^+-d TOTAL CROSS SECTIONS BETWEEN 1.55 AND 3.30 GeV/c. Abrams, R. J.; Cool, R. L.; Giacomelli, G.; Kycia, T. F.; Leontic, B. A.; Li, K. K.; Michael, D. N. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Lett., 19: 259-61(July 31, 1967). (BNL-11504).

Two new I = 1 structures about 0.2 mb in height are observed in K^+-p and K^+-d total cross section measurements at cm energies of 2190 ± 10 and 2505 ± 10 MeV. (auth)

35269 SINGLE PION PRODUCTION IN PION-PROTON INTERACTIONS BETWEEN 1 AND 3 GeV. Howard, Charles Gordon. Athens, Ohio, Ohio Univ., 1966. 165p.

Thesis.

Properties of dipion resonances and pion-nucleon resonances are studied in π^-p and π^+p single pion production interactions between 1 and 3 GeV. Production and decay distributions of the rho and N^{*++} are compared to the predictions of the single particle exchange models. Eight sets of data in this energy range were obtained from different experimental groups. The kinematical quantities of the particles for each event were stored on magnetic tape, and histograms, Dalitz plots, spin density matrix elements, and other results were calculated from the tape by an IBM 360 Model 40 computer. The one-pion-exchange model of Gottfried and Jackson does not explain ρ^0 decay distributions below 1.71 GeV/c. The T = 0, S-wave enhancement, ϵ^0, is seen at ~730 MeV in the $\pi^+\pi^-$ effective mass spectrum for all data combined with $\Delta^2/\mu^2 \leq 4$ and $|\cos\theta_{\pi\pi}| < 0.3$. Repopulating the interference region of ρ^+ N^{*++} with conjugate events is shown to be the most successful method to eliminate this interference for spin density matrix element calculations from ρ^+ decay. Spin density matrix element calculations for N^{*++} decay are compared with the rho exchange model of Stodolsky and Sakurai between 0.91 GeV and 1.26 GeV. Due to the limited π^+p data, the values obtained are not conclusively in agreement or disagreement with the model. (Disser. Abstr.)

35270 SECONDARY MAXIMUM IN PION-PROTON ELASTIC SCATTERING FROM 2.5 GeV/c TO 6.0 GeV/c. Ettlinger, Lester Andrew. Ann Arbor, Mich., Univ. of Michigan, 1966. 64p.

Thesis.

The differential cross section for elastic scattering of pions by protons between 2.5 and 6.0 GeV/c was measured in a spark chamber experiment at the Argonne ZGS. There is a secondary maximum in the differential cross section in the region $.6 < |t| < 2.8$ $(GeV/c)^2$, which decreases smoothly as a function of increasing beam momentum. For a given momentum of the incident pion, the scattering cross sections for π^+p and π^-p at the peak of the second maximum are equal, within statistical errors, in all cases. The pion-nucleon charge exchange cross section is seen to exhibit a secondary maximum at approximately the same value of t and is compared with the elastic scattering distributions. The effect of N* resonances on the elastic scattering distributions is discussed. (Disser. Abstr.)

35271 DIFFERENCES BETWEEN π^+p AND π^-p ELASTIC SCATTERING IN THE DIFFRACTION PEAK REGION. Saulys, Alfred Casimir. Ann Arbor, Mich., Univ. of Michigan, 1966. 53p.

Thesis.

The differential cross sections of π meson-proton elastic scattering were measured in a spark chamber experiment at incident pion momenta from 2.3 GeV/c to 6.0 GeV/c. The method of analysis of the data and the differences between π^+ and π^- elastic scattering in the diffraction peak region at 2.5, 3.0, and 3.5 GeV/c are discussed. In the course of this experiment approximately 700,000 spark chamber photographs were analyzed. For this purpose a cathode ray tube type automatic scanning system was developed, which is described in detail. In comparing the π^+ and π^- elastic scattering in the diffraction peak region it was found that when the differential cross sections for values of the 4-momentum transfer variable t were fitted to an expression of the type Ae^{Bt} in the region $.05 < -t < .6$, the values of B for π^- were slightly but significantly different from those for π^+. It was also found that the ratio of $B(\pi^+)/B(\pi^-)$ agrees within experimental error with the ratio of the total cross sections $\sigma(\pi^+)/\sigma(\pi^-)$ over a wide energy range. (Disser. Abstr.)

35272 A STUDY OF NEUTRAL HYPERON AND NEUTRAL KAON PRODUCTION IN K^- + p INTERACTIONS NEAR THE Y*(1765) RESONANCE. Uhlig, Ronald Paul. College Park, Md., Univ. of Maryland, 1966. 161p.

Thesis.

The following K^- meson interactions in hydrogen are studied: $K^- + p \rightarrow \Lambda + \pi^0$; $K^- + p \rightarrow \Lambda + \pi^+ + \pi^-$; $K^- + p \rightarrow Y_1^*(1385) + \pi^+$; $K^- + p \rightarrow \Lambda + \pi^+ + \pi^- + \pi^0$; $K^- + p \rightarrow Y_1^*(1520) + \pi^0$; $K^- + p \rightarrow \Lambda + \eta$; $K^- + p \rightarrow \bar{K}^0 + n$; and $K^- + p \rightarrow \bar{K}^0 + p + \pi^-$ for incident K^- momenta between 900 and 990 MeV/c. Cross sections and angular distributions are presented and analyzed as a function of momentum. Results are interpreted in terms of the properties of the Y*(1765) resonance. Results are consistent with the existence of Y*(1765) with isotopic spin 1 and spin and parity $\frac{5}{2}^-$. Evidence is presented which shows that $\Lambda + \pi^0$, $Y_1^*(1385) + \pi$, $Y_1^*(1520) + \pi^0$, and $\bar{K}^0 + n$ are all possible decay modes of the Y*(1765). (Disser. Abstr.)

35273 SEARCH FOR A STRANGENESS +2 MESON. Joldersma, Tom. Athens, Ohio, Ohio Univ., 1966. 78p.

Thesis.

The 80" hydrogen bubble chamber at the 30 GeV/c alternating gradient synchrotron was exposed to a beam of 2.95 GeV/c K^+ mesons. Approximately 110,000 pictures were obtained, each containing an average of 15 incoming K's. The film was scanned using criteria which favored the production of a hyperon. This would assure the production of two S = +1 mesons. The events were measured on image plane digitizers, reconstructed in space using the TRED program and fit to different hypothesis using the KICK program. The correct hypothesis was confirmed or selected by ionization estimates. The final disposition of events included 71 in the K^+K^+ final state, 31 in the $K^+K^+\Sigma^0$ final state and 51 in the $K^+K^0\Sigma^+$ final state. No peak in the KK effective mass distribution is observed. The confidence level that the effective mass spectra are described by a simple phase space distribution is equal to 82 percent. Thus the data does not require the hypothesis of a KK resonance state. The confidence level for agreement with phase space for the combined world data is 72 percent, removing the suggestion of the S = +2 KK meson implied by the original CERN data. The apparent nonexistence of a S = +2 meson up to a mass of about 1600 MeV suggests that the 189 representation of SU(6) is not being filled. At the present time no multi-quark systems are thus needed to contain the observed elementary particles. (TSS) (Disser. Abstr.)

35274 SINGLE PION PRODUCTION IN π^+-p INTERACTIONS AT 1.114 GeV/c. Beam, William J. Athens, Ohio, Ohio Univ., 1966. 64p.

Thesis.

Interactions of the type $\pi^+ + p \rightarrow \pi^+ + p + \pi^0$ and $\pi^+ + p \rightarrow \pi^+ + \pi^+ + n$ at an incident pion momentum of 1.114 GeV/c are considered. The data are compared with the isobar model and with predictions of the Stodolsky-Sakurai ρ-exchange model. The BNL 20 liquid hydrogen bubble chamber was exposed to a separated π^+ beam from the BNL 3 GeV cosmotron. Approximately 4,000 two-pronged events were found in over 8,000 photographs in the chamber. Effective mass distributions of outgoing particle pairs were determined. These distributions indicate that the interactions proceed through an intermediate stage consisting of an N*(1238) isobar and a single pion in at least 50% of the cases. For events of the type $\pi^+ + p \rightarrow N^{*++} + \pi^0 \rightarrow \pi^+ + p + \pi^0$, the angle formed by the momentum vector of the N^{*++} decay pion and the normal to the production plane was computed in the N^{*++} rest system. The distributions of the cosine and cosine squared of this angle were determined for comparison with predictions of the Stodolsky-Sakurai ρ-exchange model. The data are consistent with the isobar model and are inconsistent with predictions of the ρ-exchange model. (Disser. Abstr.)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 35249.

35275 (NP-16867) RELATIVE TIME AND BETHE-SALPETER SOLUTIONS. Note No. 119. Bui-Duy, Q. (Rome Univ. (Italy). Istituti di Fisica). Apr. 29, 1967. 9p. Dep.

The physical meaning of the Bethe-Salpeter amplitudes and the role of the relative time in the Bethe-Salpeter equation are investigated. Limitation is made to physical systems whose only kinematical freedom is the time coordinate. Together with time translational invariance, the Bethe-Salpeter amplitude depends only on $t = t_1 - t_2$ which is assumed to be positive. An exactly soluble model is considered. Not only energy eigenvalues are known, but also energy eigenstates are found explicitly in terms of free states. Thus the physical meaning of the Bethe-Salpeter amplitudes becomes apparent once they are found. (J.F.P.)

35276 REMARKS ON CLASSICAL UNSTABLE PARTICLES AND THE LONG-RANGE SCALAR FIELD. Lopes, J. Leite (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Progr. Theor. Phys. (Kyoto), 37: 738-44(Apr. 1967).

A possible description of unstable particles, classically defined as those with a rest-mass depending on proper time, is examined. If one assumes the equality between inertial and gravitational masses valid for both stable and unstable particles, a universal interaction between a zero-mass scalar field and all particles, which would thus have a variable rest-mass, is allowed by this equality and has been proposed by Dicke in connection with Mach's principle. (auth)

35277 POSSIBLE COSMOLOGICAL CONSEQUENCES OF THE THEORY OF ELEMENTARY PARTICLES WITH FINITE DEGREE OF FREEDOM. Tati, Takao (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto), 37: 754-8(Apr. 1967).

The theory of finite degree of freedom introduces a universal time-like vector N_μ in the momentum space (Minkowski) in order to remove the indefiniteness of the momentum degree of freedom of elementary particles. A cosmological model (finite, with an expanding boundary) is assumed, and it is discussed that the center of mass of the universe is determined by the vector N_μ when the "maximum excitation" is assumed in an early stage of the universe. The model is closely related to the special relativity (Milne) model but deviates from it on account of the abandonment of the cosmological principle. Our model should be considered as a zeroth order approximation in a low density model. A singularity of density in low density models is discussed and it is shown that the universal vector N_μ serves also to remove this singularity. (auth)

35278 ALTERNATIVE APPROACH TO COMMUTATION RELATIONS ASSOCIATED WITH PARTICLES OF HIGHER SPIN. Lovelock, D. (Univ. of South Africa, Pretoria). Ann. Phys. (7), 19: 234-43(1967).

Starting from a purely classical (relativistic) theory it is possible to develop a quantization scheme which automatically gives rise to the relativistic wave equation, the usual spin operators and a condition (I) on certain operators. By demanding that this wave equation characterizes particles with unique rest mass values, a second set of conditions (II) is derived, depending on an integral parameter n. From I and II the relations which constitute the Dirac electron and Kemmer meson theories are obtained in full by choosing n = 2 and n = 3 respectively. The consequences of invoking the requirement that the wave equation characterizes particles with several distinct rest mass values instead of unique rest mass values are considered. A third set of conditions (III) is then deduced (which are to replace II) and these also depend on an integral parameter n. From I and III the Madhava Rao commutation relations for particles of spin $\pm\frac{3}{2}\hbar$ and $\pm 2\hbar$ are then derived by choosing n = 4 and n = 5 respectively. In addition the rest mass values deduced by Bhabha from an alternative viewpoint arise quite naturally. (auth)

Electromagnetic

Refer also to abstracts 35410 and 35427.

35279 (JINR-P2-3338) POLYARIZATSIYA V π-e-RASSEYANII I ELEKTROMAGNITNYI FORMFAKTOR π-MEZONA. (Polarization in π-e Scattering and Electromagnetic Form Factor in π-Meson). Bilen'kii, S. M.; Semikoz, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 10p. (In Russian). Dep.

Electron polarization in π-e-scattering in the energy region up to the $\pi + e \to 2\pi + e$ reaction threshold is calculated. In this region the polarization is determined by the meson (π) electromagnetic form factor. (auth)

35280 RADIATIVE DECAYS OF DYNAMICAL RESONANCES. Yamada, Masao (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 37: 881-94(May 1967).

Production amplitudes for the three processes $\pi + N \to e^\pm + e^+ + N$, $\pi + \rho \to e + e^+ + \pi^0$ and $\pi + \pi \to e + e^+ + \pi$ are analyzed using the N/D method. Some self-consistency conditions are derived for various electromagnetic form factors. Effective coupling constants for $N^* \to N + \gamma$ are obtained, which are consistent with experiment. The width due to the decay $\omega \to \pi^0 + \gamma$, Γ_ω, is calculated to be 0.84 MeV, while that due to the decay $\rho \to \pi + \gamma$ becomes zero or very small. (auth)

35281 STRUCTURE AND EXCITATION MECHANISM OF THE N* IN PHOTOPRODUCTION $\gamma + p \to N^*$. Fujimura, Kimio; Kobayashi, Tsunehiro; Kobayashi, Tetsuro; Namiki, Mikio (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 37: 916-40 (May 1967).

The photoproduction of nucleon resonances $\gamma + p \to N^*$ is theoretically examined in the framework of the fundamental triplet model of hadrons. The partial width of the decays $N^* \to N + \gamma$ and of the Breit-Wigner formula for the processes $\gamma + p \to N^* + \pi$ are obtained in terms of the internal quantum numbers and the structure parameters of the N and N*'s. The basic assumption is as follows: The nucleon and its resonance levels are well described by the non-relativistic bound state wave functions of three constituent particles. Both the nucleon and the (3,3)-resonance, $N_{\frac{3}{2}}$, belong to the 56-dimensional representation of the SU_6, and are further characterized by the S-wave internal space wave function. The other resonances are regarded as the single particle excitation mode in which one of the constituents is in a higher angular momentum state. The electromagnetic interaction is U-spin invariant and its exchange current effect is neglected. First it is shown that the selection rule for electric and magnetic multipoles to induce the process $\gamma + N \to N^*$ is completely fixed by the above assumption and an additional hypothetical relation L + S = J which may be called the Kycia-Riley relation, where L, S and J are the internal orbital, spin and total angular momentum, respectively. Both the electric and magnetic multipoles ($E_{J-\frac{1}{2}}$ and $M_{J+\frac{1}{2}}$) contribute to the excitation of the $N^*_{J,J}$'s with $I = (\frac{1}{2})$, while only the magnetic multipole transition ($M_{J-\frac{1}{2}}$) is necessary for the excitation of the $N^*_{J,J}$'s with $I = (\frac{3}{2})$, I being the isospin of the resonance levels. Consequently the $N^*_{\frac{1}{2}}(1400)$ excitation would be much suppressed in agreement with experiment. The partial widths for various N* excitations are numerically obtained. It is shown that the existing experimental data on the $N^*_{\frac{3}{2}}$ and $N^*_{\frac{1}{2}}$ are consistent with them if the spatial extension of the bound state is put nearly equal to the nucleon Compton wave length. It is also noted that only the partial width of the $N^*_{\frac{3}{2}}$ photoexcitation is not sensitive to the core radius in the long photon wavelength approximation and in the SU_6 symmetric limit of the internal space wave function. (auth)

35282 INTERPRETATION OF $\eta \to 3\pi$ AND $K \to 2\pi$ BY MESO-STRONG INTERACTIONS. Nakamura, Seitaro (Tokyo Univ.) Sato, Shigeo; Igarashi, Masataka; Inami, Takeo; Murai, Nobuyuki; Sato, Akira. Progr. Theor. Phys. (Kyoto), 37: 986-1002(May 1967).

By introducing some kinds of meso-strong interactions between baryons and mesons besides the known kinds of the strong interactions, a number of the forbidden decay modes, such as $\eta \to 3\pi$(G-parity forbidden), $K^+ \to 2\pi(\Delta I = \frac{1}{2}$ rule violating) and $K_2^0 \to 2\pi$ (CP-law violating) are shown to be explained in the unified way. Even the assumption of a meso-strong interaction which violates the CP-law and can, therefore, be responsible for $K_2^0 \to 2\pi$, does not lead to the considerable amount of violation of charge symmetry of pions (π^+ and π^-) emitted in $\eta \to 3\pi$ (~2.8% violation at the most). (auth)

35283 PION PRODUCTION AT 0^0. Drell, S. D.; Sullivan, J. D. (Stanford Univ., Calif.). Phys. Rev. Lett., 19: 268-71 (July 31, 1967). (SLAC-PUB-312).

The special features of forward pion photoproduction at high energies are discussed. It is established that the cross section for single pion production can generally be expected to have a forward dip barring a conspiracy between Regge trajectories. Photoproduction of the A_1 (1^+) meson followed by its decay is suggested as an important source of high-energy forward pions. (auth)

35284 THEORY OF DIBARIC PARTICLES. Polovina, N. N. Ukr. Fiz. Zh., 12: 896-901(June 1967). (In Russian).

Generalization of Kemmer's algebra is considered, which leads to particles with two-mass states. A minimum polynom for $\beta_\lambda(\sigma)$ is found, on the base of which a complete system of covariant operators for designing is constructed. An expression for differential section of dibaric particle scattering by Coulomb field in the Born approximation is obtained. (auth)

35285 ANGULAR DISTRIBUTION IN PION ELECTROPRODUCTION. Zagury, N. (Harvard Univ., Cambridge, Mass.). Notas Fis., Cent. Brasil. Pesqui. Fis., 12: 195-219(1967).

The results of previous work are used to calculate the angular distribution of mesons (π) for different contributions to the cross

section for the interactions $e^- + p \rightarrow e^- + p + \pi^0$ and $e^- + p \rightarrow e^- + n + \pi^+$. Also the variations on these angular distributions when the meson (π) form factor is changed are analyzed. It is found that the shape of the longitudinal meson (π^+) cross section is quite sensitive to this quantity. The effect of adding ω and ρ exchange is considered. Their contribution is found small for the range of energies and momentum transfer considered and of the order of other uncertainties in the theory. (J.F.P.)

35286 CURRENT ALGEBRA AND FORM FACTORS OF THE AXIAL-VECTOR CURRENT. Sato, Akira; Yokoo, Yoshimatsu; Takahashi, Junji (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 37: 716-26(Apr. 1967).

Sum rules which relate the axial-vector and the induced pseudoscalar form factors of the nucleon to the pion electroproduction amplitude are derived on the basis of the equal-time commutators among axial charges and vector currents. In the approximation retaining only the (3,3) resonance contribution to the pion electroproduction amplitude, the axial-vector form factor is found to be almost equal to the Dirac form factor and the induced pseudoscalar form factor is dominated by the pion pole term. (auth)

35287 PHOTOPRODUCTION OF PIONS AT THE SECOND PION-NUCLEON RESONANCE. Hatano, Shigeaki (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), 37: 702-9(Apr. 1967).

The resonant amplitudes for the single pion photoproduction from the nucleon are calculated at the second pion-nucleon resonance. A simple model is used, in which the second resonance and nucleon ground states are represented by solutions of the Klein–Gordon equation with effective potentials chosen suitably. The amplitudes for the electric dipole and the magnetic quadrupole transitions, E_{2-} and M_{2-}, and the total cross section for the resonant photoproduction of neutral pions are computed. The main features of the resonant photoproduction process are well explained by this simple model. (auth)

Weak

Refer also to abstracts 35282, 35297, and 35531.

35288 (NP-16868) FINITENESS OF RADIATIVE CORRECTIONS TO $\pi\beta$-DECAY. Note No. 124. Cabibbo, N.; Maiani, L.; Preparata, G. (Rome Univ. (Italy). Istituto di Fisica). May 29, 1967. 8p. Dep.

In order to determine the finiteness of radiative corrections to $\pi^- \rightarrow \pi^0 + e\bar{\nu}$ the graph where the $e\bar{\nu}$ pair is emitted through the axial part of the hadronic weak current is considered. This contribution is added to the matrix element for the π^- decay discussed. A sum rule is found which ensures that cancellation in a particular case would be universal, and the radiative corrections would then turn out to be finite in the physical π^- beta decay as well as in any other vector beta decay. (J.F.P.)

35289 RADIATIVE PIONIC DECAYS OF HYPERONS. Toda, Azuma (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 37: 895-903(May 1967).

Under the assumption that the radiative pionic decays of hyperons $Y \rightarrow B + \pi + \gamma$ can be described as the nonleptonic hyperon decays with inner bremsstrahlung, the decay amplitudes of $Y \rightarrow B + \pi + \gamma$ were evaluated from those of $Y \rightarrow B + \pi$. Sum rules were obtained for both the parity-violating and -conserving amplitudes, under the requirement that the "nonleptonic weak vertex" must be consistent with the following three conditions: i) $\Sigma^+ \rightarrow n + \pi^+$ is the pure p wave decay, ii) $\Sigma^- \rightarrow n + \pi^-$ is the pure s wave decay and iii) the triangle relation of Lee-Sugawara holds. (auth)

35290 NONLEPTONIC SIGMA DECAYS. Deans, S. R.; Holladay, W. G.; Mickens, R. E. (Vanderbilt Univ., Nashville). Progr. Theor. Phys. (Kyoto), 37: 870-80(May 1967).

With the help of the $|\Delta T| = \frac{1}{2}$ rule the three nonleptonic sigma decay modes are described by four complex amplitudes with phases given by time reversal invariance. The four magnitudes are explicitly expressed as functions of four measurable quantities, the three decay rates and the parameter α_-. The remaining decay parameters are then written in terms of four measurable quantities. These relations take account of the scattering phase shifts, the differences in phase space for the three decays, and possible inequalities in the decay rates. The relations are used (a) to check the validity of the $|\Delta T| = \frac{1}{2}$ rule and time reversal invariance, (b) to calculate parameters of the decay that have not yet been measured and (c) to discuss the importance of measuring β_1. (auth)

35291 LEPTONIC DISINTEGRATION OF THE BARYONS. Gabos, Z. Stud. Univ. Babes-Bolyai, Ser. Math.-Phys., 12: No. 1, 91-5(1967). (In Rumanian).

The correlation which exists between the polarization of the electron and the polarization of the baryon B_2 is investigated. These particles are formed as a result of the leptonic disintegration of the baryon B_1. (auth)

35292 CURRENT X CURRENT INTERACTION AND $|\Delta I| = \frac{1}{2}$ RULE. Hara, Yasuo (International Centre for Theoretical Physics, Trieste, Italy. Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 37: 710-15(Apr. 1967).

The $|\Delta I| = \frac{3}{2}$ amplitudes of hyperon decays are shown to be negligible in the limit of zero pion four momentum even if under the assumption that the nonleptonic weak interaction is a product of the weak charged current and its hermitian conjugate. (auth)

35293 RADIATIVE CORRECTIONS TO NEUTRINO–ELECTRON PROCESSES. Hebb, Mathilde Jeannette. Pasadena, Calif., California Inst. of Tech., 1967. 107p.

Thesis.

The lowest order electromagnetic radiative corrections to electron-positron annihilation into neutrino and antineutrino and to neutrino scattering by electrons are calculated. The pair annihilation corrections are used to calculate the radiative corrections to stellar neutrino luminosities in the temperature range in which the zero order process gives the dominant contribution. The corrections to the neutrino-electron scattering cross section are those relevant to a proposed experiment detecting scattered electrons with more than a minimum recoil energy whether or not a bremsstrahlung photon is emitted. The results depend logarithmically on an ultraviolet cut-off in the same way as does the lowest order vacuum polarization diagram of electrodynamics. When the cut-off is taken to be on the order of the nucleon mass the luminosity is enhanced by as much as 10 percent below $T \sim 10^{9}$°K and depressed by ~1 percent for $T > 10^{9}$°K. The scattering cross section is depressed by ~4 percent for the incident neutrino energies ~8–14 MeV of the proposed experiment. A characteristic distance, the neutrino charge radius, is associated with a charge distribution of the neutrino and depends on the cut-off. With the cut-off at the nucleon mass the charge radius of the electron neutrino is estimated to be two orders of magnitude smaller than the experimental limit. The possible effects of a charge radius larger than the estimate are also considered. It is found that interference between the electromagnetic and weak couplings could depress both the nonrelativistic stellar luminosity and the scattering cross section, but that if the scattering cross section is found to be as large as expected, the luminosity must be also. (Disser. Abstr.)

35294 LEPTON POLARIZATION IN PRODUCTION OF N* BY NEUTRINOS. Song, Hi Sung. Ames, Iowa, Iowa State Univ., 1966. 65p.

Thesis.

The differential cross sections for the processes $\nu_l + N \rightarrow N^* + l$ and $\bar{\nu}_l + N \rightarrow N^* + \bar{l}$ are considered for a polarized outgoing lepton. The interaction Hamiltonians are expressed in terms of fourteen form factors. The spin $\frac{3}{2}$ polarization and projection operators are obtained. There are four types of terms for the differential cross sections, one depending on momentum transfer only, one proportional to $\vec{M} \cdot \hat{s}$, one proportional to $\vec{N} \cdot \hat{s}_\perp$, and one proportional to $(\vec{N} \times \vec{M}) \cdot \hat{s}$, where $\vec{N}$, $\vec{M}$, $\hat{s}$, and $\hat{s}_\perp$ are the momentum of N*, the momentum of the outgoing lepton, the unit vector along the polarization direction, and the component of $\hat{s}$ perpendicular to $\vec{M}$, respectively. Three different special cases, such as zero outgoing lepton mass, small m_M/E_M and $\vec{N}/m_N$ for the high energy neutrino beam, and transverse polarization of the outgoing lepton, are considered in order to discuss the validity of time-reversal-invariance, the current-current form for the interaction Hamiltonian, and γ_5-symmetry for the lepton current. The experimental tests for these four types of terms in the differential cross sections will decide which of the above assumptions for the interaction Hamiltonian is correct. Finally, it is suggested that the consideration of the polarization cross sections might determine which set of the several sets of form factors, obtained by several authors, is the suitable one when the above assumptions for the interaction Hamiltonian are correct. (Disser. Abstr.)

Strong (General)

35295 (AD-651038) A REGGE-QUARK MODEL OF HADRON SCATTERING. James, P. B.; Logan, R. K. (Illinois Univ., Urbana. Dept. of Physics). 1967. Contract N00014-66-C-00010-A05. 10p. CFSTI.

One of the unique features of the quark model is that one obtains relations between baryon–baryon cross sections and meson–baryon cross sections. A Regge quark model analysis was recently performed in which agreement between these relations and experiment was obtained only after a scale factor was introduced (N. Ahmadzadeh, Phys. Letters v22 p96 1966) in the N–N amplitude. It is now shown how this agreement may be obtained without introducing such a factor. (auth) (TAB)

35296 (JINR-P2-3359) OB UCHETE TREKHCHASTICHNYKH SIL MEZHDU KVARKAMI PRI VYSOKOENERGETICHESKOM RASSEYANII ADRONOV. (On the Account of Three-Particle Forces by Quarks in High Energy Hadron Scattering). Zaikov, R. P.; Stoyanov, D. Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 9p. (In Russian). Dep.

A possibility is considered of obtaining the relations between the total scattering cross sections as well as between differential cross sections of some inelastic hadron collisions, considering that the quark forces are three-particle and the quark-antiquark ones paired. (auth)

35297 BBP COUPLING CONSTANTS IN BROKEN SU(3) AND NONLEPTONIC HYPERON DECAYS. Toda, Azuma; Takagi, Fujio (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 37: 1040-1(May 1967).

The correlation between the strong BBP coupling constants in the broken SU(3) and the p-wave amplitudes of nonleptonic hyperon decays is discussed in terms of the Nishijima model for nonleptonic decays. In this model the effective Hamiltonian for nonleptonic decays was given by a commutator of the seventh component of weak octet currents and the strong interaction Hamiltonian. (L.B.S.)

35298 DISPERSION ANALYSIS OF ELASTIC SCATTERING OF HIGH-ENERGY PARTICLES. Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Fortschr. Phys., 14: 741-69(1966).

The discussion of the dispersion analysis of high energy elastic scattering includes the zero-angle elastic scattering amplitude, the behavior of the cross sections in the high energy region, elastic $\pi^- + p$ scattering with charge exchange at zero angle, and the real part of the elastic $\pi^\pm + p$ scattering amplitude. The scattering of protons and antiprotons on protons is also considered. (J.F.P.)

35299 INTERNAL MOVEMENT OF HADRONS AND INFINITE-COMPONENT WAVE EQUATION. Takabayasi, Takehiko (Univ. of Nagoya, Japan). Progr. Theor. Phys. (Kyoto), 37: 767-8(Apr. 1967).

An equivalent representation of the covariant quantum theory for the particle model with internal structure represented by a spinor variable is given in terms of an infinite-component wave function. A few remarks are then made on the theory viewed as field theory. (L.B.S.)

35300 HIGH-ENERGY FORWARD SCATTERING AND THE URBARYON MODEL. Imachi, Masahiro; Sawada, Shoji (Univ. of Nagoya, Japan). Progr. Theor. Phys. (Kyoto), 37: 759-61 (Apr. 1967).

The total cross sections and the angular distribution of elastic forward hadron-hadron interactions are discussed in terms of urbaryon-urbaryon scattering. (L.B.S.)

Strong (Baryon No. = 0)

Refer also to abstract 35300.

35301 (NP-16862) SUPERCONVERGENT PHASE-SHIFT, ASYMPTOTIC REGGE RESIDUA AND ELASTIC-WIDTH VS. MASS RELATIONS. Note No. 123. Srivastava, Yogendra (Rome Univ. (Italy). Istituto di Fisica). May 20, 1967. 8p. Dep.

Under fairly general assumptions, a superconvergent relation for the phase-shift (spin or no spin) is written down purely in terms of its Regge singularities. Using them directly at the resonance energies, yields a simple relation between the elastic width and the mass of a resonance. As a by-product, Khuri's (assumed) bound on the residue function, $|\beta(s)| \leq s^{-\frac{1}{2}}$ is shown to be essentially saturated. The results are in quantitative agreement where data are available. (auth)

35302 REMARKS ON S-WAVE PION-PION SCATTERING. Furuichi, Susumu (Rikkyo Univ., Tokyo); Kanada, Hiroyuki; Watanabe, Keiji. Progr. Theor. Phys. (Kyoto), 37: 1045-6(May 1967).

A summary of information on the S-wave pion-pion scattering is given. This information was obtained through indirect measurement of a pion production by pion-nucleon production. An exact solution of the Chew-Mandelstam dispersion relation is reported for pion-pion scattering for a wide range of the coupling constant; the results were found to be inconsistent with the indirect measurement of the phase shifts and scattering lengths. (L.B.S.)

35303 DECAYS OF 2^+-MESONS AND PAIR SUPPRESSION PRINCIPLE. Ninomiya, Kansuke (Univ. of Nagoya, Japan). Progr. Theor. Phys. (Kyoto), 37: 1036-8(May 1967).

The decays of 2^+-mesons into two pseudoscalar mesons are investigated by regarding the 2^+-mesons as composite systems of $\bar{q}$, $\bar{q}$, q, and q in the S-wave. This is made possible by employing a primitive picture in which the SU(3)-indices of any nonet correspond to real quarks. (L.B.S.)

35304 PRODUCTION OF ABNORMAL BOSONS. Sugano, Reiji (Osaka City Univ.). Progr. Theor. Phys. (Kyoto), 37: 1030-2(May 1967).

A discussion of production of the abnormal boson and of the possibility that a δ(965 MeV) boson may be one of the abnormal bosons is given. An abnormal boson is defined as one for which the G-parity opposite to an ordinary one is assigned. (L.B.S.)

35305 IS THERE A PION CONSPIRACY? Phillips, R. J. N. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Phys., B2: 394-407(1967).

A possible conspiracy, between the pion Regge pole and an opposite-parity pole, is considered. It would help to reconcile theory with experiment, for high-energy NN and $\bar{N}N$ charge exchange, where there are severe difficulties otherwise. The conspirator pole is arranged to give no light 0^+ meson, but may give a heavy 2^+ meson. (auth)

35306 ANTIPROTON-PROTON ANNIHILATION INTO K MESONS. Yeh, Noel Kuei-eng. New Haven, Yale Univ., 1966. 195p.

Thesis.

Annihilation of the antiproton-proton system into K-mesons and pions was studied. The total cross section for $\bar{p} + p \rightarrow K + \bar{K} + m\pi$ where $m \geq 1$ is (2.9 ± 0.4) mb at 3.66 BeV/c and (2.5 ± 0.5) mb at 6.935 BeV/c, which represents, respectively, (9.0 ± 1.5)% and (10.2 ± 3.1)% of the total annihilation cross section. No two-body reactions of the form $\bar{p} + p \rightarrow K + \bar{K}$, $K^* + K$, $K^* + \bar{K}^*$ were observed. The production angular distributions of kaons for three-body final states show striking anisotropy but the effect diminishes with increasing multiplicity. The total resonance production cross section decreased with the increase in beam momentum. At 3.66 BeV/c, copious production of $K^*(890)$, ρ and ω was observed in several channels, while at 6.935 BeV/c some $K^*(1400)$ was observed. No evidence was found for the formation of the φ meson, and upper limits on the φ/ω production ratio are presented. The data are consistent with no simultaneous production of resonances. A low mass (threshold to ~1060 MeV) enhancement in the $K\bar{K}$ system was observed with probable quantum numbers I, $J^{PC} = 1,0^{+-}$, and was compared with the $K\bar{K}$ effect noted previously by several groups. A search for resonances in the $K\pi\pi$ system at 1175, 1215 and 1270 MeV, as well as in the $K\bar{K}\pi$ system at 1280 and 1410 MeV yielded negative results. (Disser. Abstr.)

Strong (Baryon No. = 1)

Refer also to abstracts 35300 and 35413.

35307 (UCRL-17572) K^+n CHARGE EXCHANGE AND THE ρ' REGGE TRAJECTORY. Schwarzschild, Bertram M. (California Univ., Berkeley. Lawrence Radiation Lab.). June 8, 1967. Contract W-7405-eng-48. 43p. Dep. CFSTI.

Thesis.

Finding that the Regge exchange of ρ and A_2 fails to describe the K^+n charge-exchange data at 2.3 GeV/c (the highest energy available to date) when a simultaneous fit is attempted with higher energy data on K^-p and π^-p charge exchange and $\pi^-p \rightarrow \eta^0 n$, a second, lower lying ρ-type trajectory (ρ') is introduced. This also provides a possible mechanism for the puzzling π^-p charge-exchange polarization. It is found that one is then able simultaneously to fit all these data (including the polarization), together with related total cross section differences up to 20 GeV/c, with a ρ' whose spin-1 mass is 1.0 GeV [perhaps the δ(965) ?] and whose $t = 0$ intercept, 1.1 units of angular momentum below the ρ, agrees roughly with the ρ' proposed by Högaasen and Fischer to describe forward $\bar{p}p$ and np charge exchange, where the (ρ,A_2) model also fails. The ρ and A_2 trajectories turn out to be essentially traditional. In the fit only small SU_3 breaking between the $K\bar{K}$ and $\pi\pi$ (or $\eta^0\pi$) couplings to the trajectories is permitted. The fit is further constrained to obey the sum rule of Igi and Matsuda. In fitting the K^+ data at 2.3 GeV/c, a deuteron correction is included, and exact Legendre functions rather than the high-energy asymptotic Regge forms are employed. Predictions for higher energy K^+ charge exchange are offered. (auth)

35308 CONSISTENT INTERPRETATION OF ULTRA HIGH ENERGY PHENOMENA. Koshiba, Masatoshi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 37: 1042-4(May 1967).

Conclusions concerning a new baryon found in investigations of ultrahigh energy interactions in large nuclear emulsions stacks are summarized. This new baryon is called the ν-baryon. It has a

mass between 1960 and 2100 MeV, strangeness zero, isospin ½, and spin-parity possibilities of $\frac{1}{2}^+$, $\frac{3}{2}^+$, $\frac{5}{2}^+$, $\frac{1}{2}^-$, and $\frac{3}{2}^-$. The details of the experiment are to be reported in other journals. (L.B.S.)

35309 MESON–BARYON COUPLING CONSTANTS IN THE QUARK MODEL. Takagi, Fujio (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto), 37: 1047-8(May 1967).

The sum rules for the DBP and BBP coupling constants based on a simple quark model are given. D, B, and P are the $J^P = (\frac{3}{2})^+$ decuplet, $(\frac{1}{2})^+$ octet, and 0^- octet respectively. The possibility of improving the predicted value of Γ ($N^* \rightarrow N + \pi$) by the representation mixing is also discussed. (L.B.S.)

35310 CLUSTER MODEL OF HADRONS. Fukushima, Yoshihiro (Kyushu Univ., Fukuoka); Otsuki, Shoichiro; Sawada, Shoji; Toyoda, Fumihiko. Progr. Theor. Phys. (Kyoto), 37: 964-85 (May 1967).

A model is proposed in which most of baryon resonances are understood as octet and decuplet composite systems of the $\frac{1}{2}^+$ octet baryon and the 0^- octet meson. A classification of baryons based on the model is proposed in the form of periodic table. Experimental results and phenomenological rules to suggest such a cluster structure of baryons are explained. The mass formula of the model is capable of explaining most of observed baryon resonances. Interactions between the constituent baryon and meson are shown almost independent of their isospin, hypercharge and relative angular momentum. The spin-orbit coupling part of the interactions is found to be consistent with the sign of polarization of recoil protons in π-N scattering. (auth)

35311 KINEMATIC INTERPRETATION OF THE LOW-MASS $K\pi\pi$ ENHANCEMENT IN $Kp\pi\pi$ FINAL STATES. Dornan, Peter J. (Brookhaven National Lab., Upton, N. Y.); Barnes, Virgil E.; Kalbfleisch, George R.; Skillicorn, Ian O.; Goldberg, Marvin; Goz, Barton; Wolfe, Richard; Leitner, Jack. Phys. Rev. Lett., 19: 271-5(July 31, 1967). (BNL-11466).

Semiquantitative evidence that one may interpret the $K\pi\pi$ enhancement in the final state $pK^0\pi^0\pi^-$ at 4.6 and 5.0 GeV/c as being due to the operation of four meson-exchange processes, all characterized by elastic scattering at the bottom vertex, and thus leading to Deck-effect peaking in $M(K\pi\pi)$, is presented. In addition to the usual diagram, ρ production via K exchange and both K^* and ρ production via vector meson exchange are considered. (J.F.P.)

35312 NEGATON–POSITON PAIR CREATION IN PION–NUCLEON INTERACTIONS. Loubaton, J. P.; Tran Thanh Van, J. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys., B2: 342-6(1967).

Recently, in two experiments for the η^0 study, electron pairs at large angle were found. $\pi + N \rightarrow N + e^+ + e^-$. The number of events is relatively small and some estimates of total cross sections were made. The process is evidently related to pion electroproduction. The only difference is the sign of the invariant square mass of the virtual photon. In the electroproduction experiments, the transfer is space-like while in the pair-production experiments it is time-like. The e^+e^- pair-production experiments are particularly interesting because they permit one to measure the nucleon form factors in a range $0 \leq k^2 \leq 4m_N^2$, which is out of reach for electroproduction or annihilation experiments. The differential cross section for pair production in the one-photon exchange approximation is very simply related to the transverse and longitudinal inverse pion photoproduction with a virtual photon. An evaluation of the differential cross section and of the total cross section for pair production was made. Comparison with experiments gives an excellent agreement. An experiment at the $N^*_{\frac{3}{2}\frac{3}{2}}$ resonance energy is suggested to give the nucleon form factor for time-like transfer up to $k^2 = 2.5$ fm^{-2}. (auth)

35313 QUARK MODEL AND TWO-BODY REACTIONS. Kawaguchi, Masaaki (Osaka Univ.). Progr. Theor. Phys. (Kyoto), 37: 772-3(Apr. 1967).

Some relations for various two-body reactions which follow from a simple quark model are given. The basic assumption is that the forward scattering amplitude for any reaction is the sum of all possible contributing two-body quark-quark or quark-antiquark scattering amplitudes. (L.B.S.)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 35300, 35351, and 35426.

35314 (COO–1112-104) DIFFRACTION MODEL FOR STRONG INTERACTIONS AND THE SHRINKAGE OF THE DIFFRACTION PEAK. Krisch, A. D. (Michigan Univ., Ann Arbor. Harrison M. Randall Lab. of Physics). [1966]. Contract AT(11-1)-1112. 17p. Dep. CFSTI.

The diffraction model for strong interactions at high energies is considered. A model with a spherically symmetric interaction probability density which is squashed down in the direction of the motion by the Lorentz contraction is assumed. This model leads to the prediction that the differential elastic scattering cross section $d\sigma/dt$ should depend only on $\beta^2 p_1^2$. When the p + p and π + p elastic data are plotted against this variable, the energy dependence is removed. Thus this model seems to offer a kinematic explanation for the well-known shrinkage of the diffraction peak. (J.F.P.)

35315 (JINR–E1-3420) EFFECT OF TENSOR MESON EXCHANGE ON N–N SCATTERING. Azhgirei, L. S.; Chizhikov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1967. 7p. Dep.

The coupling constants of the scalar (σ), pseudoscalar (π), vector (ω and ρ) and tensor (f) mesons are determined by the least squares method from the elastic nucleon–nucleon scattering phase shifts. It is shown that the account of the tensor meson in terms of one-boson-exchange model leads to a better description of the experimental $^3P_{0,1,2}$ and $^3D_1$ phase shifts of N–N scattering in the energy region of 25–330 MeV. (auth)

35316 (JINR–E2-3345) SIMULTANEOUS PHASE SHIFT ANALYSIS OF 210 MeV NUCLEON–NUCLEON SCATTERING. Yanout, Z.; Kazarinov, Yu. M.; Legar, F.; Winternitz, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1967. 34p. Dep.

A phase-shift analysis at 210 MeV was performed with $l_{max} = 5$. New data on the differential cross section, polarization and triple scattering parameters were used. A single solution was obtained as a result of it. The angular dependence of experimental values are shown in diagrams. Relativistic formulas for recoil particle triple scattering parameters are given. (auth)

35317 HARD CORE AND ABSORPTION IN A TWO-CHANNEL MODEL FOR PROTON–PROTON COLLISION. Hida, Gyo; Sawada, Shoji; Yano, Tadashi; Yonezawa, Minoru (Hiroshima Univ. Univ. of Nagoya, Japan). Progr. Theor. Phys. (Kyoto), 37: 692-701(Apr. 1967).

The effect of hard core on absorption in proton-proton collision up to a few GeV is examined by a spinless two channel model with $p + p \rightarrow p + p$ and $p + p \rightarrow p + N^*$. It is shown that the strong s-wave absorption can be obtained for the energy near the inelastic threshold even in the presence of hard core. The importance of the non-local real potential due to the competing inelastic processes is emphasized on the problem of hard core. (auth)

35318 BARYON–BARYON REACTIONS AND SU3 SYMMETRY. De Souza, Patrick David. University Park, Md., Univ. of Maryland, 1966. 90p.

Thesis.

SU(3) symmetry has been used in order to obtain relations between the cross-sections for baryon-baryon reactions in the $^1S^0$ and $^3S^1$ states. The modifications of these relations for higher angular momentum states are derived and it is shown that the possible existence of strong coupling of the $^3D^1$ state to the $^3S^1$ state does not invalidate the above derived relations. In order to investigate the effect of mass splitting on these results a potential model calculation is carried out in order to verify the predicted equality of $^1S^0$ n-p and Σ^+-p cross-sections. The calculation indicates that this relationship is indeed satisfied and that further Σ^--n system has a possible bound singlet state with a binding energy $\lesssim 1$ MeV. The multichannel Σ^--p reactions are investigated with an SU(3) invariant K-matrix using the Λ–p parameters of Burnstein and Alexander. A calculation of Σ^--p cross sections is carried out for center of mass energies <10 MeV. The results of this calculation are not in agreement with experiment. (Disser. Abstr.)

Particle Invariance Principles and Symmetries

General

35319 (IC–67/50) CLEBSCH–GORDAN COEFFICIENTS FOR THE LORENTZ GROUP. I. PRINCIPAL SERIES. Anderson, R. L.; Raczka, R.; Rashid, M. A.; Winternitz, P. (International Centre for Theoretical Physics, Trieste (Italy)). July 1967. 31p. Dep.

Explicit expression for the Clebsch–Gordan coefficient for the unitary representations of the principal series for the SL(2,c) group is obtained. Their orthogonality and symmetry properties are discussed. Special cases of physical interest are dealt with in detail. (auth)

35320 (JINR-P2-3334) OPERATORY KAZIMIRA DLYA GRUPPY O(n). (The Casimir Operators for the Group O(n)). Nikolov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 19p. (In Russian). Dep.

A method of finding the eigenvalues of the Casimir operators of an arbitrary order for group O(n) is developed; the formulas defining the irreducible representations of O(n) obtained by Gel'fand and Zetlin are used. The suggested method essentially differs (due to the specific features of the above mentioned formulas) from that applied by Perelomov and Popov for the same purpose. The results essentially differ as well (the definitions of the Casimir operators are different); the result obtained here is more effective. (auth)

35321 EXISTENCE OF THE DYNAMIC SYMMETRIES O_4 AND SU_3 FOR ALL CLASSICAL CENTRAL POTENTIAL PROBLEMS. Fradkin, D. M. (Wayne State Univ., Detroit). Progr. Theor. Phys. (Kyoto), 37: 798-812(May 1967).

It is found that all classical dynamic problems (relativistic as well as nonrelativistic) involving central potentials, inherently possess both O_4 and SU_3 symmetry. This leads to a generalization of both the Runge-Lenz vector in the Kepler problem and the conserved symmetric tensor in the harmonic oscillator problem. For a general central potential, an explicit construction of the elements of the Lie algebra of O_4 and SU_3 in terms of canonical variables is given. The question of a possible quantum-mechanical analog is discussed. Also, a constructive technique is given for imbedding the Lorentz group and SU_3 in an infinite-dimensional Lie algebra. (auth)

35322 GENERATORS OF A MOTION AND COVARIANT FIELDS. Poncet, J. (Univ., Lausanne, Switzerland). Helv. Phys. Acta, 40: 436-64(July 1, 1967). (In French).

An N-field is defined under weaker covariance conditions than for a local field. (N is a set in which SL(2,C) operates.) In particular, the energy-momentum of an N-field is given by unitary representations R(n): a $\rightarrow R_a(n)$ of the translations a, depending on n in N, which are covariant under a representation $M: A \rightarrow M_A$ of SL(2,C) (M determines the angular momentum) in the sense: $R_{A\,a}(An) = M_A R_d(n) M_A^{-1}$. It is shown that if N is the set of time-like directions a definition of the "interaction picture" is possible, which resembles in some way the conventional one and therefore permits bypassing the conclusions of Haag's theorem. An example of an N-field is constructed which is obtained by an "interaction picture" from a free field. Properties of its energy-momentum are discussed. Some results on generators of evolutions are given. (auth)

35323 THE q-NUMBER SCHWINGER TERM AND THE BREAKDOWN OF THE ASSOCIATIVE LAW FOR CURRENT OPERATORS. Konisi, Gaku; Yamamoto, Kunio (Kwansei Gakuin Univ., Nishinomiya, Japan. Osaka Univ.). Progr. Theor. Phys. (Kyoto), 37: 734-7(Apr. 1967).

It is suggested that there cannot exist the q-number Schwinger term which was discussed by Buccella, Veneziano, Gatto and Okubo in order to explain incompatibility of the usual commutation relations of current operators with the Jacobi identity. The incompatibility arises from the fact that current operators do not satisfy the associative law of multiplication. This is because they are not the ordinary linear operators but distribution-valued operators on the Hilbert space. (auth)

35324 SYMMETRY CONCEPTS IN MODERN PHYSICS. Iqbal Memorial Lectures. Salam, Abdus. Lahore, Atomic Energy Center, 1966. 60p.

The book contains a series of five lectures which outline man's search for unity in the understanding of the physical universe and the ultimate nature of matter. A historical review is given of man's systematic search for the basic constituents of matter, the ultimate discovery of the elementary particles, and attempts to understand the nuclear force. Unitary symmetry as the basic underlying symmetry of the nuclear force is also discussed. (C.E.S.)

Applications (Electromagnetic and Weak)

35325 (AD-650951) VIOLATION OF CP INVARIANCE AND NONLEPTONIC DECAYS. Nishijima, K.; Swank, L. J. (Illinois Univ., Urbana. Dept. of Physics). 1967. Contract N00014-67-A-0305-0005. 13p. CFSTI.

Since the experimental discovery of the decay mode $K_2^0 \rightarrow \pi^+ + \pi^-$, a number of theoretical propositions were made. A new scheme is proposed for nonleptonic decays on the basis of the assumption that both CP-conserving and violating nonleptonic decays should be ascribed to the same primary interaction. (auth) (TAB)

35326 MESON PHOTOPRODUCTION ON NUCLEONS AND SU(4)-SYMMETRY. Rekalo, M. P. Ukr. Fiz. Zh., 12: 886-95 (June 1967). (In Russian).

Consequences of various models of SU(4)-symmetry for the processes of pseudoscalar and vector meson photoproduction are considered. Meson formation in s-state is studied on the basis of nonrelativistic SU(4)-symmetry, which is an isotopic analogue of SU(6)-symmetry. A dipole model of photoproduction of π-mesons on nucleons near a threshold, united with SU(4)-symmetry, for the processes of nucleon isobar formation leads to consequences contradicting to the experimental data. Formation of mesons in p-state, γ-quanta of a magnetic dipole type being absorbed, is investigated on the basis of a static model of SU(4)-symmetry. A resonance behavior of the amplitude M_3 corresponding to the complete angular moment, $3/2$ being supposed, an isotopic structure of the amplitude M_1 corresponding to the angular moment $1/2$ can be predicted. Formation of mesons under the angles 0 and 180° is studied within the limits of a collinear $SU(4)_W$-symmetry. The amplitudes of photoproduction of π^0- and η-mesons on a proton in this case must be comparable by their values. (auth)

35327 COMPLEX SPIN AND DECAY $K_2^0 \rightarrow 2\pi$. Sannikov, S. S. (Physico-Technical Inst., Kharkov). Nucl. Phys., B2: 326-8(1967).

The theory of the decay $K_2^0 \rightarrow 2\pi$ based on the concept of complex spin is given. The complex spin gives rise to CP conservation (in the sense of the definition) in the decay considered. (auth)

35328 ASYMPTOTIC CHIRAL SYMMETRY. Schechter, J.; Venturi, G. (Univ. of Chicago). Phys. Rev. Lett., 19: 276-9 (July 31, 1967). (COO-264-388; EFINS-67-46).

A general consistency between the predictions of asymptotic chiral SU(3) invariance and the extrapolations to large spacelike momentum transfer of the usual phenomenological fits to vector and axial-vector baryon form factors is pointed out. It is found that the use of asymptotic chiral SU(3) invariance leads (in order of increasing speculation) to the following three consistencies with extrapolations of vector and axial-vector form factors: for large q^2 the induced form factors fall off faster than the direct ones, a good value for the axial d/f ratio at zero-momentum transfer energies, and a plausible expression for the axial-vector renormalization constant is found. (J.F.P.)

35329 ASYMPTOTIC SU(3), SUPERCONVERGENCE, AND THE K_{l3} FORM-FACTOR F_+. Pandit, L. K. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev. Lett., 19: 263-5(July 31, 1967).

Assuming that in the asymptotic region of large S, the π_{l3} and K_{l3} form factors f(S) and $F_+(S)$ are related by the SU(3) symmetry, a superconvergence relation is suggested, from which, on saturation by the ρ and the K^*, the approximate result $F_+(0) = -(1\sqrt{2})M_\rho^2/M_{K^*}^2$ is obtained. (auth)

35330 SYMMETRIES AND WEAK INTERACTIONS. Das, Tapaskumar. Philadelphia, Univ. of Pennsylvania, 1966. 121p.

Thesis.

The internal symmetry properties of weak interactions, in which leptons also play an active role are investigated. Since SU(3) works so well for the hadrons, it is interesting to speculate on whether an SU(3)-theory of weak interactions can be constructed including the leptons. The possibility of higher symmetry schemes for weak interactions is also studied. Regarding the higher symmetry schemes it is shown that symmetry schemes higher than SU(3) are not at all natural and at least they do not serve any particularly useful purpose. The rank 3 group, Sp(6) is treated extensively as a good representative example. On the other hand it was found that an SU(3) theory of weak interactions including leptons can be constructed; all CP-invariant weak interactions can be put in a single framework which at the same time exhibits some intrinsic symmetry-structure of weak interactions. In order to put leptons into irreducible representations of SU(3), the existence of two charged heavy leptons was postulated so as to have two SU(3)-triplets corresponding to the muonic and the electronic leptons. All weak interactions are then viewed as taking place in a "weak" SU(3)-space which has "weak" isospin I' and "weak" hypercharge Y' as its conserved quantities. The eigenstates of I' and Y' are formed out of mixing the physical particle states which are the octets of hadrons and the triplets of leptons. In complete parallelism to strong interactions the weak interaction Lagrangian as consisting is viewed of a weak SU(3)-symmetric part and a part which is asymmetric along the weak hypercharge axis. All the well-known results of the weak decays are derived and the suppression of $|\Delta S| = 1$ leptonic and $\Delta I = 3/2$ and $|\Delta S| = 2$ decays is naturally explained. It is also discussed how the symmetry-structure of weak interactions as described by the above theory can survive even when strong interaction effects of hadrons are turned on. From the point of view

presented, strong and weak interactions exhibit "conflicting" isomorphic symmetries. There is no difference between strong and weak interactions so far as the internal symmetry properties are concerned. The reason why the strong interaction is said to conserve isospin and hypercharge, while the weak interaction is believed to violate them can possibly be traced to the overwhelming disparity between coupling strengths of strong and weak interactions. (Disser. Abstr.)

Applications (Strong)

35331 (COO-1112-111) SOME CONSEQUENCES OF SU(3) AND CHARGE CONJUGATION INVARIANCE FOR K-MESON RESONANCES. Kane, Gordon L. (Michigan Univ., Ann Arbor). [1966]. Contract AT(11-1)-1112. 19p. Dep. CFSTI.

Implications of invariance of strong interactions under SU(3) and charge conjugation are investigated for K-meson resonances (i.e., systems which are not eigenstates of C). It is pointed out that the charge conjugation eigenvalue of the neutral nonstrange members of multiplets is determined by the decays (mesonic or electromagnetic) of the strange members. The K'(1320), K'(1420), and K'(1800) are considered as examples. Possibilities for study of symmetry breaking and particle mixing in kaon resonance decays are mentioned; they may provide practical methods for studying symmetry breaking. Restrictions on Pomeranchuk exchange in K* production and the possibility of determining the SU(3) character of the Pomeranchuk trajectory are noted. (auth)

35332 (JINR-P2-3407) MASSOVYE FORMULY V LESTNICHNYKH PREDSTAVLENIYAKH GRUPPY U(6,6). (Mass Formulae in Ladder Representations of Group U(6,6)). Nikolov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 10p. (In Russian). Dep.

On the basis of natural physical assumptions a mass operator is constructed which acts in the space of the ladder series of unitary representations of group U(6,6). This operator is used to obtain mass formulas for baryons and mesons under the assumption that they are classified according to the representations mentioned. The relations obtained well agree with experiment: in the case of baryon 56-plet the relative errors do not exceed 0.8% (formulas for the first mass powers) and in the case of meson nonets with spin-parity 0^-, 1^-, and 2^+ they do not exceed 0.5% (formulae for quadratic masses). (auth)

35333 KINETIC SUPERMULTIPLETS MODEL. Maiani, Luciano; Preparata, Giuliano (Istituto di Fisica Nucleare, Florence). Ann. Ist. Super. Sanita, 2: 695-706(1966).

A model for the classification of higher (positive parity) mesons and (negative parity) baryon resonances is described, based on the intuitive model of quark bound states with a nonvanishing total orbital angular momentum. The mesons are described as a p-wave quark-antiquark system, and the baryons as a 3-quark system with total orbital momentum equal to one. The comparison with the experimental evidence is also presented, and turns out to be rather encouraging. Various sum rules for masses are, in fact, satisfied by data, and also the presence of a mesonic resonance at near 960 MeV is predicted, for which experimental evidence was recently reported. (auth)

35334 NONUNIQUENESS OF MASS FORMULAS FROM INFINITE-DIMENSIONAL GROUPS AND ALGEBRAS. Flato, Moshe; Sternheimer, Daniel (Coll. de France, Paris). Phys. Rev. Lett., 19: 254-5(July 31, 1967).

The possibility of getting any mass spectrum one desires in the framework of infinitely generated infinite-dimensional associative algebras and unitary groups is discussed. Inevitable consequences for the mass problem are then suggested. (auth)

35335 ANTIPROTON ANNIHILATION INTO TWO MESONS AND HIGHER SYMMETRIES. Makarov, A. A.; Nguyen van Hieu; Winternitz, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Fortschr. Phys., 14: 771-801(1966).

The annihilation of antiprotons on nucleons is investigated assuming various symmetry groups. The general structure of the transition amplitude is found for the unitary symmetry and the higher symmetries SL(6,C) and U(6,6) are applied to annihilations at rest. The relations between matrix elements, amplitudes and cross sections, following from various symmetries, that can be compared with experiments, are in good agreement, whereas the stronger results of the U(6,6) symmetry contradict experiments. (auth)

35336 DECAY OF THE 35-PLET IN THREE OCTETS. Zimerman, A. H.; Segre, E. R. A. (Instituto de Fisica Teorica, Sao Paulo, Brazil). An. Acad. Brasil. Cienc., 38: 390-9(Dec. 31, 1966).

The general Hamiltonian for the interaction between a 35-plet and relations for resonance production from this interaction are given. The tensor basis for the 35-plet, the form of the interaction with the baryon and two-meson system, and some relations between the effective amplitudes for decay and production are given. The broken Hamiltonian and some sum rules which can be derived for the coupling constants are also considered. (J.F.P.)

35337 SU_3 BREAKING BY AN ISOTRIPLET: SPIONS AND THE FIFTH INTERACTION. Banyai, L.; Marinescu, N.; Rittenberg, V.; Weiner, R. M. (Inst. of Physics, Bucharest). Progr. Theor. Phys. (Kyoto), 37: 727-33(Apr. 1967).

A model is proposed for SU_3 breaking through a "fifth" semistrong interaction mediated by an isotriplet of bosons. This model yields a formula equivalent to the G-M-O mass formula, as well as a new sum rule which may explain the $\Sigma-\Lambda$ mass difference. Possible candidates for this new interaction might be spinning pions. Assuming that spions have semistrong interaction and postulating that they break the μ-e symmetry by a direct coupling with the $\mu\nu_\mu$ current, one could explain their nonobserved e_2 decay. (auth)

35338 INTERNAL MOVEMENT OF HADRONS AS INFINITE-DIMENSIONAL REPRESENTATION OF INNER LORENTZ GROUP. Takabayasi, Takehiko (Univ. of Nagoya, Japan). Progr. Theor. Phys. (Kyoto), 37: 765-6(Apr. 1967).

A model with internal structure described by a Weyl spinor is considered. The first-order covariant wave equation that describes the motion of the internally structured model for a free case is given in complete accord with quantum mechanics and relativity theory. The equation corresponds to infinite-dimensional unitary representations of the internal Lorentz group. (L.B.S.)

35339 SYMETRIES DE TYPE LORENTZIEN ET INTERACTIONS FORTES. (Symmetries of Lorentzian-Type and Strong Interactions). Flato, Moshe. Paris, Gauthier-Villars Editeur, 1967. 152p.

The discussion of Lorentzian-type symmetries and strong interactions includes Lorentz groups and space-time geometry, relation between internal and external formalisms, and applications of the theory to strong interactions. Remarks are also made on existing strong interaction theories. (J.F.P.)

Quantum Field Theories

35340 (NP-16842) CURRENT: DIVERGENCE COMMUTATOR. Capra, F. (Paris Univ., Orsay (France). Laboratoire de Physique Theorique et Hautes Energies). May 1967. 7p. (TH-202). Dep.

The equal time commutator of an axial current and an axial divergence is calculated with the help of a low-energy theorem of pion-nucleon scattering. Comparing the result with the σ model, a relation between the mass, the coupling constant and the vertex form factor of the σ meson is derived. The result is also found to be consistent with the estimates of Weinberg, thus justifying the usual neglect of terms containing current-divergence commutators. (auth)

35341 HAMILTONIAN FORMULATION OF ACTION-AT-A-DISTANCE IN ELECTRODYNAMICS FOR TWO SPIN-HALF CHARGED PARTICLES. Nigam, B. P. (Arizona State Univ., Tempe. Univ. of Wisconsin, Milwaukee). Progr. Theor. Phys. (Kyoto), 37: 786-97(May 1967).

The results of a previous paper, in which, following Kerner's work, the Hamiltonian formulation of the Wheeler-Feynman theory of action-at-a-distance in classical electrodynamics has been carried out to obtain the classical (relativistic) Hamiltonian and the corresponding quantum-mechanical Hamiltonian operator (both to order e^4 and c^{-4}) for two spinless charged particles, are generalized to describe the interaction between two spin-half charged particles. The spin has been introduced phenomenologically into the Hamiltonian of two spinless charges by developing a set of rules to do this. To order e^2 and $(v/c)^2$ the spin-dependent Hamiltonian derived is found to be in agreement with the Breit interaction. (auth)

35342 THE STUECKELBERG FORMALISM FOR RARITA-SCHWINGER FIELD WITH SPIN 3/2. Watanabe, H. (Tokyo Univ. of Education); Shimodaira, H.; Kamefuchi, S. Nucl. Phys., B2: 360-8(1967).

A Lagrangian theory for a Rarita-Schwinger field with spin $\frac{3}{2}$ and nonvanishing mass is reformulated along a line similar to the Stueckelberg formalism for vector fields. In addition to a spinor-vector field, two auxiliary spin-$\frac{1}{2}$ fields with positive and negative norms are introduced. The Hilbert space is necessarily of an indefinite metric. Some properties of state vectors, which are subject to certain subsidiary conditions, are discussed. (auth)

35343 DIRAC-SCHWINGER COVARIANCE CONDITION AND APPLICATIONS TO QUANTUM ELECTRODYNAMICS. Brown,

Stanley Gordon. Philadelphia, Univ. of Pennsylvania, 1966. 135p.

Thesis.

For covariance the structure relations of the Poincare group must be satisfied by the operators of a quantum field theory. In theories in which the Poincare generators are given by integrals over an energy-momentum tensor density, the structure relations are equivalent to the Dirac-Schwinger condition, which in its simplest form relates the equal-time commutator of the energy density to the momentum density. (The general form of the Dirac-Schwinger condition may contain additional terms which do not contribute to the relevant integrals.) A theorem of Schwinger states that the condition is satisfied in simplest form for a large class of theories, with the energy-momentum density obtained from a first-order Lagrangian by the Balinfante prescription. This theorem is twice proven again for "canonical theories," i.e., theories in which the canonical commutation relations may be assumed consistently with the constraint equations. The first new proof shows that the theorem holds for canonical theories because (1) all field components transform explicitly as tensors; this assures convariance; (2) the simplicity of the commutation relations prevents additional terms from appearing in the energy density commutator. This first proof is valid to lowest order in $\hbar$ or in classical field theory. The second new proof, which is valid to all orders in $\hbar$ in quantum field theory, consists of the direct evaluation of the energy density commutator. The proof is given for the "preferred subclass" of canonical theories in which products of two or more dependent field components do not appear in the first-order interaction Lagrangian; in this subclass, the expressions for dependent field components do not involve roots of field operators or denominators which are operators. In order for the proof to apply to canonical theories outside the preferred subclass, one must set $\partial_i \delta^3(0) = 0$ on symmetry grounds. The integrability condition required for consistency of the Schwinger-Tomonaga covariant formulation of field theory in the interaction picture is shown to imply the Heisenberg picture Dirac-Schwinger condition. For canonical theories, the two conditions would be equivalent if the interaction picture existed. The Lee-Yang anomalous moment vector meson electrodynamics without ζ-limiting is outside the preferred subclass. Application of the Dirac-Schwinger condition to this theory leads to ambiguous extra terms involving $\partial_i \delta^3(0)$ in order κ^4 and higher. An alternative theory of anomalous moment electrodynamics has been formulated which is in our subclass and, hence, free of these ambiguities. In spinor electrodynamics with a Pauli moment, the Dirac-Schwinger condition is satisfied, but the equations of motion are apparently non-covariant under Lorentz transformation. This happens because the equation of motion involves double commutators which are more singular than the single commutator of the Dirac-Schwinger condition. The terms in the energy density and the manipulations of the operators which lead to the difficulty are identified. (Disser. Abstr.)

35344 NECESSITY OF PRODUCTION AMPLITUDES IN QUANTUM FIELD THEORY. Cheung, Franklin Fan-Keung. College Park, Md., Univ. of Maryland, 1966. 173p.

Thesis.

Previously, it was proved by S. Aks that production amplitudes are necessary in scattering of two neutral scalar particles with pairing symmetry. The proof is generalized to scattering of two particles with arbitrary spins and isotopic spins. The generalization is done by steps. Specific cases are first considered like pion-pion scattering, neutral scalar particle without pairing symmetry and the pion-nucleon scattering, which are gradually extended towards the general case of arbitrary spins and isotopic spins. The result shows that quite generally, consistency between crossing symmetry and unitarity condition requires the existence of production processes in two particle scattering. It is taken as a working model that the scattering amplitudes satisfy the analyticity requirements of Mandelstam representation with a finite number of subtractions; but later it is shown how the result follows directly from unitarity condition, crossing relation and analyticity that can be established from the axioms of quantum field theory. It is assumed that there is no production processes in one channel, say the s-channel. Then the elastic unitarity condition is valid in the whole range of $\infty > s_0 \geq s \geq (m_1 + m_2)^2$ and the Landau curves on the real s-t plane will in general be asymmetric in s and t, which is incompatible with crossing relations unless the double density functions are zero identically. However, the double density functions are related with the crossed channels absorptive parts through elastic unitarity integrals, and vanishing of the former will imply vanishing of these absorptive parts. If one now makes a partial wave expansion of the scattering amplitudes in t or u channel, one is able to conclude that the scattering amplitudes themselves must vanish identically in that channel. By crossing, one can then infer that the scattering amplitudes vanish identically in all three channels, provided there are no production processes in one channel. (Disser. Abstr.)

Scattering Theory

35345 (IC-67/55) INELASTIC N/D EQUATIONS AND REGGE THEORY. Warnock, R. L. (International Centre for Theoretical Physics, Trieste (Italy)). July 1967. 52p. Dep.

The practical and theoretical aspects of N/D equations are considered. The discussion covers physical values of the angular momentum in the direct channel, but with account taken of Regge asymptotic behavior in the limit of infinite direct channel energy. The inelastic N/D equation is derived, and a generalized form of the Levinson theorem is proved. The behavior of partial waves at infinity in Regge theory is considered, and the Fredholm character of the N/D equations in Regge theory is demonstrated. Also a tentative proposal for dynamical calculations with Regge trajectory exchange is described. (J.F.P.)

35346 (JINR-P2-3330) S-MATRITSA V DVUKHMERNOI MODELI POLYA BORNA-INFEL'DA. (S-Matrix in Two-Dimensional Model of Born-Infeld Field). Barbashov, B. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 22p. (In Russian). Dep.

The S-matrix is built on the basis of the asymptotic solutions of nonlinear equation describing the Born-Infeld scalar field in the two-dimensional space (x,t). The difference is discussed between the approaches based on the Heisenberg motion equations and that on the interaction representation. Only the first approximation gives a correct result when finding the S-matrix by means of the perturbation theory. The found S-matrix leads to the particle scattering process which is reduced to the change of the plane wave phase proportionally to the colliding particle momenta. (auth)

35347 (NP-16844) APPROACH TO THE PROBLEM OF SCATTERING ON SINGULAR MULTICHANNEL POTENTIALS. Note No. 104. Marchioro, C. (Rome Univ. (Italy). Istituto di Fisica). July 12, 1966. 9p. Dep.

An iterative method for the evaluation of the partial wave scattering amplitude produced by a spherically symmetrical multichannel potential is presented. (auth)

35348 (NP-16869) ASYMPTOTIC UNITARITY CONSTRAINTS ON REGGE MULTIPOLES AND CUTS. Note No. 122. Srivastava, Yogendra (Rome Univ. (Italy). Istituto di Fisica). May 10, 1967. 7p. Dep.

Some constraints implied by the asymptotic unitarity condition on the possible forms of Regge singularities are discussed. Under certain assumptions, it is found that a Regge (simple) pole is insufficient. (auth)

35349 (NP-16870) CONDENSATION OF REGGE CUTS, VANISHING TOTAL CROSS-SECTIONS AND TWISTING TRAJECTORIES. Note No. 120. Srivastava, Y. (Rome Univ. (Italy). Istituto di Fisica). May 5, 1967. 6p. Dep.

It is conjectured that the simplest way to avoid the $J = \alpha(0)$ problem (condensation of infinite Regge cuts there) is to have the Pomeranchuk intercept slightly less than one. Thus cross sections would asymptotically tend to zero. Experimental evidence in this regard is quite unclear. However, with hypothesis, the leading singularity generated by the parent Regge pole in collusion with the Pomeranchuk pole (which is assumed straight) is constantly changing its curvature (twist effect). Some evidence in support of a twisted leading singularity is presented. (J.F.P.)

35350 TOTAL CROSS SECTIONS AT HIGH ENERGIES. Hara, Yasuo (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto), 37: 941-63(May 1967).

High energy behaviors of forward elastic scattering amplitudes of particles with spin ≤ 1 are studied by making use of the Regge pole model. In the model forward elastic scattering amplitudes are expressed in terms of four types of Regge trajectories associated with the four types of S = 0 mesons, (i) $P = (-1)^J$, $C = (-1)^J$, (ii) $P = (-1)^J$, $C = -(-1)^J$, (iii) $P = -(-1)^J$, $C = (-1)^J$, (iv) $P = -(-1)^J$, $C = -(-1)^J$. The relation between two Regge trajectories is found to be one of the following four types. (A) Mother and Daughter, $\alpha(i)j(0) = \alpha(ii)j(0) \pm 1$ and $\alpha(iii)j(0) = \alpha(iv)j(0) \pm 1$. There are relations among pole residues such as $[\beta_{(iii)_j}(0)]^2 = (2\alpha_j + 1)\,\alpha_j^{-1}(\alpha_j + 1)^{-1}[\beta_{(iv)_j}(0)]^2$ for $\alpha(iv)j(0) = \alpha(iii)j(0) + 1 = \alpha_j$. A mother and its daughter have opposite signatures. (B) Twin, $\alpha(i)j(0) = \alpha(iii)j(0)$ and $\alpha(ii)j(0) = \alpha(iv)j(0)$. There are relations among pole residues such as $[\beta_{(iii)_j}(0)]^2 = \alpha_j(\alpha_j + 1)^{-1}[\beta_{(i)_j}(0)]^2$ for $\alpha(i)j(0) = \alpha(iii)j(0) = \alpha_j$. A twin has a same signature, and a member of a twin can be a mother or daughter. (C) Isolation. The relations between α and/or the relations between β are not satisfied. (D) Father and Son, $\alpha(i)j(0) = \alpha(iv)j(0) \pm 1$ and $\alpha(ii)j(0) = \alpha(iii) \pm 1$. A father and its son have op-

posite signatures. The consequences of the model with and without these assumptions to high energy forward elastic scattering amplitudes are studied. (auth)

35351 THE UNITARITY CONDITION OF THE S-MATRIX FOR HIGH ENERGY ELASTIC SCATTERING. Kobayashi, Kozo (Saitama Univ., Urawa, Japan). Progr. Theor. Phys. (Kyoto), 37: 904-15(May 1967).

The inelasticity of the intermediate states in the unitarity condition of the S-matrix is investigated for high energy elastic scattering of strongly interacting particles. The inelastic process is treated as the multiple production of mesons, for which we have assumed statistical independence. The energy-momentum conservation law in the intermediate states is derived in terms of the meson momentum distribution, and it is shown that the effective intermediate states are in general varied with the elastic scattering angles. The property of the intermediate states is discussed with existing experimental data on the multiple meson production. In high energy accelerator researches and analyses of cosmic ray jet, it has been revealed that the momentum distribution of the secondaries is sharply peaked in the longitudinal direction and the average transverse momentum is constant independent of the incident energies. From these experimental results, it is shown that the inelasticity of the intermediate states responsible for large angle elastic scattering is quite small compared with that for small angle elastic scattering. (auth)

35352 COMPOSITE PARTICLE AND VERTEX FUNCTION IN THE NONRELATIVISTIC OFF-SHELL THEORY. Mishima, Nobuhiko (Aoyama Gakuin Univ., Tokyo); Yamazaki, Miwae. Progr. Theor. Phys. (Kyoto), 37: 1003-28(May 1967).

Weinberg's quasiparticle method is extended to the useful form having good correspondence to the on-shell S-matrix theory and giving a unique definition of vertex function and propagator of composite particle in the nonrelativistic off-shell theory. A method is proposed, by which the off-shell scattering amplitude is separated into two parts: one having no composite particle pole and satisfying the unitarity under the on-shell condition, and the other consisting of vertex functions and propagator related to the composite particle. This new separation has complete correspondence to the one in the usual on-shell S-matrix theory. It is shown that proper and improper vertex functions and form factor, which satisfy the on-shell unitarity, can be defined in the off-shell theory by using Weinberg's eigenfunction. Analytic continuation formulas for the form factor, vertex functions and amplitudes into the second sheet are obtained in rather peculiar forms. Further, it is shown that both bound state and resonance can be treated in the parallel way. (auth)

35353 CUSPIDAL POINTS ON LANDAU SINGULARITIES. Westwater, M. J. (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta, 40: 389-400(July 1, 1967).

A necessary and sufficient condition on a Feynman graph, whose dual diagram is normal, for its leading Landau singularity to have cuspidal points is given. It is shown how an equation determining the location of these points may be written down and the method is illustrated by some examples. (auth)

35354 DETERMINATION OF THE SCATTERING AMPLITUDES FROM POLARIZATION MEASUREMENTS. Simonius, Markus (Illinois Inst. of Tech., Chicago). Phys. Rev. Lett., 19: 279-81(July 31, 1967).

A necessary condition is proved for the set of polarization measurements which have to be performed for a full determination of the scattering amplitudes at fixed angles. The special cases of resonance scattering, Regge poles, and potential scattering are discussed. (auth)

35355 ANALYTIC CONTINUATION OF GROUP REPRESENTATIONS. V. Hermann, Robert (Stanford Linear Accelerator Center, Calif.). Contract AT(04-3)-515. Commun. Math. Phys., 5: 157-90(1967). (SLAC-PUB-245).

The connection between analytic continuation of group representations and analytic continuation of their matrix elements is discussed, together with some related problems concerning the group-theoretic nature of the S-matrix, and the asymptotic behavior of the special functions of mathematical physics. (auth)

35356 AN EXTENSION OF THE FADDEEV FORMALISM TO COMPOSITE-PARTICLE SCATTERING. Mishima, Nobuhiko (Aoyama Gakuin Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 37: 745-53(Apr. 1967).

In order to obtain the general formulation of composite-particle scattering in the three-body Faddeev formalism, Weinberg's separation of the T-matrix into a part including a composite-particle pole and a remaining part is applied to the two-body T-matrix in the Faddeev equation. By this procedure, the Faddeev equation is reduced into coupled integral equations, where one of their kernels is just the solution of the generalized Lovelace equation coming from the pole parts of the two-body T-matrices. From these coupled integral equations, a generalized composite-particle scattering amplitude can be obtained, in which the amplitude is defined by using the off-shell form factor and is the analytic extension of the amplitude defined by the residues at the poles corresponding to the composite particles. It is noticeable that, in this formulation, bound state and resonance are treated in the unified way. (auth)

35357 S-MATRIX DESCRIPTION OF THE DECAY OF UNSTABLE STATES. Wiley, David Stewart. Princeton, N. J., Princeton Univ., 1966. 280p.

Thesis.

A simple, nonrelativistic potential model is used to describe the decay of unstable states in terms of the S matrix. It is shown that the decay amplitude for an unstable state can always be written as an integration over a suitable path on the physical sheet in the form $a(t) = \int_C [f(E)/D(E)]\, e^{-iEt}\, dE$, where D(E) is the Fredholm determinant and f(E) depends on the details of production of the unstable state via the boundary value problem. Various modifications of the Lee model are used to explicitly calculate time dependent unstable states and decay curves, in order to exhibit their intimate connection with S matrix parameters. In particular, the Fredholm determinant is discussed in detail, including its analytic continuation onto the unphysical sheets through the one-channel section of the cut. A zero of the continued Fredholm determinant is shown to have the correct physical characteristics to be used in the definition of mass and lifetime of the unstable state, which is consistent with the appearance of the canonical exponential decay term in a(t) when this zero of D(E) is picked up by an integration path suitably deformed onto the second sheet. In general it is found that the analytic behavior of f(E) can significantly influence the time dependence of the decay amplitude. However, if the decay is weak relative to all competing interactions, it is shown that a time regime exists in which purely exponential decay dominates, with the dominate features of the decay arising solely from the Fredholm determinant. Of course, for t small compared with the lifetime, production dependent effects in a(t) are found to be important; also, for large t a(t) approaches the canonical asymptotic series in (1/t). Remainder terms are investigated in order to ascertain the range of validity of the asymptotic expansions. Because of the several equivalent prescriptions one can use to write the decay amplitude, and because of the explicit dependence on the Fredholm determinant in these representations, the usually discussed connection between the location of resonances in scattering reactions, the location of poles in analytically continued S matrix elements, and the intrinsic lifetime of unstable states is indeed observed and exploited. For specific initial states and cut-off functions the decay amplitude is worked out in detail in the various time regimes. Various ways of defining the mass and lifetime are explored, with appropriate physical interpretations being given within the context of time dependent theory; the relation of the initial state to the (unstable) zeroth order perturbation eigenstate of H is stressed in this connection. Higher order zeroes in D(E) and poles at the identical energy in the production function are shown to multiply the exponential decay term by a polynomial in t. Unstable intermediate states in scattering reactions are investigated, with the dependence of their amplitude and lifetime on both the Fredholm determinant and the form of the wave packet being exhibited. The one-channel and two-channel scattering problems are completely solved using a model in which the potential is spatially symmetric and the unperturbed Hamiltonian has a discrete eigenstate imbedded in the continuum scattering states; the results are expressed as the ratio of two infinite sums of determinants containing only the potential. The analytic behavior of the Fredholm determinant is examined for a wide class of cut-off functions. Other modifications of the Lee model are discussed with particular emphasis given to D(E), its analytic properties, and its zeroes on unphysical sheets, the latter being intimately associated with the definition of mass and lifetime of an equivalent unstable state. (Disser. Abstr.)

Particle Accelerators

Refer also to abstracts 34387, 34388, 34450, 34509, and 35036.

35358 (CERN-67-19) TRANSVERSE COHERENT BEAM PHENOMENA IN COLLIDING BEAM DEVICES. Pellegrini, C.; Sessler, A. M. (European Organization for Nuclear Research, Geneva (Switzerland)). July 18, 1967. 30p. Dep.

A general formalism is developed for the analysis of the transverse coherent motion of beams in a strong focusing storage ring. Both coherent and incoherent forces arising from either direct or wake fields are included in the analysis. The beams, in the ab-

sence of coherent motion, may move along different orbits which have both time and/or space crossings. The analysis applies to beams with arbitrary longitudinal density variations. The well known results for a single coasting or bunched beam are recovered, but now generalized to include the relatively minor influence of an A-G structure. Previous results for two bunched beams which were strongly dependent on the assumed azimuthal symmetry of the machine, are now significantly modified. The analysis leads to simple ways of evaluating the coherent motion, for any given structure, and for bunched (electron) and unbunched (proton) beams. One interesting result is that for a suitable choice of the number of bunches and of the Q-value, all coherent modes are stable. The analysis also shows that a strong beam with a small coherent amplitude, can drive a weak beam to large amplitude. (auth)

35359 (CONF-660527–, pp 37-41) A COMPLETELY AUTOMATED VAN DE GRAAFF ACCELERATOR. Whalen, James F. (Argonne National Lab., Ill.).

At Argonne an on-line dual computer system is used to control the major parameters of a Van de Graaff accelerator. This computer system simultaneously accumulates and processes experimental data. The executive program exercises specific methods of control during closed-loop experiments. Several currently operating experiments involve programmed executive control by the computer. (auth)

35360 (EUR–3474.f) RECHERCHE ET SYNTHESE D'UN MATERIAU THERMOSTABLE A HAUTE TENEUR EN HYDROGENE ISOTOPIQUE ET FABRICATION D'UNE NOUVELLE CIBLE POUR LA PRODUCTION DE NEUTRONS DANS LES ACCELERATEURS. (Research for and Synthesis of a Thermostable Material of High Isotopic Hydrogen Content, and Fabrication of a New Target for Neutron Production in Accelerators). Peeters, J. M.; Guillaume, M. A. (Liege Univ. (Belgium). Institut de Chimie). May 1967. 70p. (In French). Dep.

With a view to improving the characteristics of the present tritium targets used for 14-MeV neutron production, research was undertaken with the aim of developing a target of novel design, composed of a high polymer in which the tritium forms an integral part of the molecule. The material chosen for the task was the polyphenyl $(C_6H_4)_n$, a thermostable polymer that can be tritiated by direct synthesis using the T_2 gas isotope. A deuterated polyphenyl target was produced after the main stages had been prepared as follows: quantitative microsynthesis of the polyphenyl from benzene, study of isotope yield from polymerising of the deuterated benzene, quantitative microsynthesis of benzene, and development of a mechanical process for fabricating thin homogeneous layers of polyphenyl on metal support. The development work on these different stages was carried out on hydrogenated and deuterated compounds. The thermal behaviour of this type of target under deuteron irradiation shows better performances than those of metal targets. (auth)

35361 (ORNL–4091, pp 209-16) SUPPORT FOR THE HIGH-VOLTAGE ACCELERATOR PROGRAM. (Oak Ridge National Lab., Tenn.).

Various instruments developed in support of the high-voltage accelerator program are discussed. These include pulsing equipment for the tandem Van de Graaff accelerator, nuclear magnetic resonance probe for magnetic field measurements, terminal generator voltage regulator for Van de Graaff accelerators, a pulse monitoring pickup, an adjustable repetition rate gate and an E–H cross-field analyzer for the 5-MV Van de Graaff accelerator, development of duoplasmatron ion sources, an inexpensive molecular sieve trap, and a liquefied nitrogen automatic control station. (B.G.D.)

35362 (UCRL–17402) BEVATRON OPERATION AND DEVELOPMENT. 52, SEPTEMBER–DECEMBER 1966. Crebbin, Kenneth C.; Frias, Robert (California Univ., Berkeley. Lawrence Radiation Lab.). May 23, 1967. Contract W-7405-eng-48. 12p. Dep. CFSTI.

The Bevatron provided beam 87.1% of the scheduled operating time this quarter and accelerated a total of 1.7×10^{18} protons. There were basically three modes of magnet pulsing this quarter, using both flattop and mezzanine type of operation. Beam height measurements were made in the south straight section and showed the beam to be 0.75 in. above the gap center line. A fracture was discovered in one of the rotor pole pieces of the main motor generators. As a result of this failure a shutdown was started which was expected to last until some time in May 1967. (auth)

35363 (UCRL–17508) THEORY OF THE RF MANIFOLD AND MEASUREMENTS ON A MODEL MANIFOLD SYSTEM. Voelker, Ferdinand (California Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1967. Contract W-7405-eng-48. 51p. Dep. CFSTI.

A system is proposed to distribute rf energy to a linear accelerator from an adjacent manifold. This system is described and a simple theory is developed to show that the voltage will be locked in the various load cavities. A method is developed to predict the frequency of adjacent modes. Various predicted values are compared with experimental results from a model rf manifold. (auth)

35364 (UCRL–17543) BEVATRON OPERATION AND DEVELOPMENT. 53, JANUARY–MARCH 1967. Allison, Robert W.; Crebbin, Kenneth C.; Frias, Robert (California Univ., Berkeley. Lawrence Radiation Lab.). June 2, 1967. Contract W-7405-eng-48. 12p. Dep. CFSTI.

Repair work on the main motor generators continued through this quarter. Construction work was started for the foundation and shielding of the new two-channel external proton beam system. The Bevatron main control room was expanded to provide additional console space to handle the increasingly complex experimental program and beam-sharing problems. The Bevatron magnet sectors were realigned on a new tilted plane to return the closed orbit to the gap center line. Repairs were made on parts of the injector system. Measurements of the linac E and wall H fields were made. (auth)

35365 (UCRL–50215) STATITRON: A LOW-ENERGY PULSED ELECTRON ACCELERATOR. Lasher, D. R. (California Univ., Livermore. Lawrence Radiation Lab.). Mar. 14, 1967. 36p. Dep. CFSTI.

The design and operation of the Statitron electron accelerator are described. This accelerator produces 0.5-nsec bursts of 175-keV electrons at a repetition rate of 60 pps. It is used for impulse response tests, as a high-intensity pulsed light source, and for electron transmission and scattering studies at low energies. (auth)

35366 ADONE DEFLECTOR: STUDIES AND DESIGN. Massarotti, A.; Puglisi, M.; Tazzioli, F. (CNEN, Frascati, Italy). Alta Freq., 34: 591-611(1965). (In Italian). (RT/EL–(65)10).

The operational principle and the design of the deflector installation, for introducing the accumulated particles into the accelerator, are described. (tr-auth)

35367 ANALYZING THE ENERGY OF A 2-MeV VAN DE GRAFF ACCELERATOR. Donneaux, E. (IISN, Liege). Bull. Soc. Roy. Sci. Liege, 36: 127-37(1967). (In French).

The principle of measurement and control of the beam energy of a 2 MeV Van de Graaff accelerator is presented with a low-cost substitute for an NMR instrument. The main feature is the adjustment of the analyzing magnet field with the help of a moving coil oscillating in the vicinity of the beam outside the chamber between the magnetic polar pieces. This coil is fed with an adjustable and highly stabilized current i and is in equilibrium under the torques from the electromagnetic force induced on the coil by the magnetic field in the current i on one hand and helicoidal springs on the other. The experimental curve $E = f(i)$ is obtained by the measurement of known nuclear reactions, specially (p,γ). Precision of the measurements and reproducibility are discussed. (auth)

35368 300 GeV SYNCHROTRON DESIGN STUDY FOR CERN. Engineer, 224: 91(July 21, 1967).

The 1964 design study was up-dated by the publication of an addendum. Further information presented includes three alternative improved designs for the injection system, consideration of questions of experimental exploitation of the machine, and revised cost estimates. (UK)

35369 ACCELERATORS. Kuellmer, Alfred. AEG Mitt., 57: 179-83(1967). (In German).

The work of the AEG in the field of accelerators is reported since its beginning. The development of the relativistic isochronous cyclotron is pursued and the propagation (distribution) of these accelerator-types in the world at hand is shown from the known number of international cyclotron conferences from 1959 to 1966. The essential features of the AEG cyclotrons are shown and the viewpoints enumerated, according to AEG cyclotrons now built. (tr-auth)

35370 DUOPLASMATRON ION BEAM SOURCE FOR VACUUM SPUTTERING OF THIN FILMS. Chopra, K. L.; Randlett, M. R. (Kennecott Copper Corp., Lexington, Mass.). Rev. Sci. Instrum., 38: 1147-51(Aug. 1967).

A variation of the von Ardenne type of a duoplasmatron ion source is described. Here the arc discharge is maintained between the cathode in the high pressure and the anode in the vacuum chamber, as opposed to the conventional arrangement in which the arc discharge is confined primarily to the high pressure chamber. This modification allows the extraction, through apertures, of a well defined ion beam of current up to 500 mA over an area ~1 cm^2 into a vacuum chamber at a pressure of

~10^{-6} Torr. The ion beam is accelerated and made to impinge on a target material for sputtering. Sequential sputtering of different targets inside the vacuum chamber is possible with the help of suitable magnetic fields. The ion beam has been used to sputter conducting, semiconducting, and insulating target materials. Typical rate of deposition of silver films at a distance of 8 cm from the target with a 50 mA, 2 kV ion beam of 8 mm diam is ~400 Å/min. Deposition rates of ~50 Å/min are obtained for SiO_2 and TiO films. Vacuum sputtered films adhere to the subtrates much more strongly than the evaporated films do. Gold and silver films grow epitaxially on rock salt substrates at ambient or lower temperatures. This vacuum sputtering process has been found to induce and stabilize new structures. For example, sputtered films of molybdenum, tantalum, tungsten (normally bcc), and hafnium, rhenium and zirconium (normally hcp) have been observed to exist in an fcc phase. Fcc structure films as thick as 2 μ have been prepared. Epitaxial growth of the fcc structures on rock salt substrates at temperatures of ~400°C are observed. (auth)

35371 HIGH POWER SLIT SYSTEM. Seiler, Richard F. (Boeing Co., Seattle). Rev. Sci. Instrum., 38: 1184-6(Aug. 1967).

A beam slit system that uses the principle of high velocity water flow through a narrow channel as a cooling mechanism for elements exposed to the beam is described. The system is for use with the Dynamitron accelerator. (L.B.S.)

35372 ION IMPULSE SOURCE WITH A HEATING CATHODE IN A MAGNETIC FIELD. Mineev, F. I.; Mineev, R. I.; Revutskii, E. I. Ukr. Fiz. Zh., 12: 981-5(June 1967). (In Russian).

An ion impulse source with a heating cathode was investigated in a magnetic field intended for a linear accelerator. Ion currents of hydrogen and nitrogen of 50 μA with the energy of 40 kW are obtained in an impulse of 400 μs duration. Atomic ion content is 95%. The source can be effectively used in a linear accelerator of protons, deutons and helium ions. (auth)

35373 CHARGED PARTICLE PARAXIAL MOTION IN THE FIELD OF AN l-1 HELICAL WINDING. Kovtun, R. I. Ukr. Fiz. Zh., 12: 919-23(June 1967). (In Russian).

Charged particle motion in a superposition of a uniform magnetic field and that of an l-1 helical winding is studied by means of the Krylov–Bogolyubov asymptotic method in the case when the particle passes one spatial period of the helical winding field in one period of its cyclotron revolution. It is shown that the asymptotic method enables one to find analytical solutions of this problem. (auth)

35374 X-RAY SPECTRA FROM ACCELERATORS IN THE RANGE 2 TO 6 MeV. Bentley, R. E.; Jones, J. C.; Lillicrap, S. C. (Royal Marsden Hospital, Sutton, Eng.). Phys. Med. Biol., 12: 301-14(July 1967).

The photon flux spectra from two 6 MeV linear accelerators and a 2 MeV Van de Graaff generator, which are in normal use for radiotherapy, were measured using a 7.5 × 7.5 cm NaI(Tl) crystal spectrometer. The x-ray beam was scattered by aluminium sheets to reduce the intensity and energy range, and the primary spectra calculated from the measured scattered spectra using the Klein–Nishina formula. The crystal spectrometer was calibrated from theoretical Monte Carlo calculations which were compared with experimentally obtained isotope spectra. The measured pulse height spectra were converted to photon flux spectra by a digital computer. Photon flux spectra were obtained for different field sizes and under different operating conditions, and the variation in the spectra over the x-ray field was investigated. The results were compared with theoretically calculated thick target spectra using published formulae for the bremsstrahlung cross-sections. (auth)

35375 USE OF GETTER-ION PUMPS IN VACUUM SYSTEMS OF LINEAR ELECTRON ACCELERATORS. Grishaev, I. A.; Myakushko, L. K.; Bazaev, Yu. M.; Terekhov, B. A. Zh. Tekh. Fiz., 37: 696-702(Apr. 1967). (In Russian).

The experience accumulated in the laboratories of the Physicotechnical Institute of the Academy of Sciences USSR on the use of titanium getter-ion pumps in linear vacuum systems is summarized. The replacement of oil-diffusion pumps with titanium pumps was started in 1959 on a 90-MeV accelerator, and later extended to 300-MeV and 2-BeV accelerations. Maximum decentralization can be achieved by using a large number of pumps, each with a capacity as low as 10 to 20 liters/sec. The pumps developed and used in the laboratories of the Physicotechnical Institute work with a preliminary vacuum of 10^{-3} mm Hg. Their average life is 1000 hours, and their titanium consumption is 0.06 mg/min. Power requirements are 20 v and 60 amp during the starting and slightly less in steady operation. Ionizer voltage is 1000 to 1500 v; ion current, up to 0.2 amp; pumping speed (at 10^{-6} to 10^{-7} mm Hg), 50 liters/sec for air and 0.4 liters/sec for argon (at a 0.2 amp ion current); vacuum limit, 5×10^{-9} mm Hg before the pump is heat-outgassed, and 5×10^{-8} after outgassing (vacuum level in the accelerator, however, is about 10^{-6} mm Hg). Getter and ion circuits can be operated independently. The outgassing of the acceleraton generally takes only one-tenth or one-twentieth the time it requires when oil diffusion pumps are used. The starting period for titanium pumps is only about one-half hour. On the 2-BeV acceleraton, however, the pumping system is kept three months in continuous operation between turn-offs for servicing because the checking of the 103 individual pumping units during the starting period would require prohibitive manpower. (auth)

35376 LINEAR ACCELERATORS FOR PROTONS: NEW DEVELOPMENTS. Nagle, Darragh E. (Los Alamos Scientific Lab., N. Mex.). Science, 157: 145-9(July 14, 1967). (LA-DC-8614).

Some of the recent developments which have made the proton linear accelerator of much higher power than earlier models more feasible are discussed. The developments in target areas and secondary beams for research are also discussed. Some of the recently proposed linear accelerators are mentioned. (B.G.D.)

35377 RAYONNEMENT ET DYNAMIQUE DU CORPUSCULE CHARGE FORTEMENT ACCELERE. (Radiation and Dynamics of Highly Accelerated Charged Particles). Arzelies, Henri. Paris, Gauthier-Villars Editeur, 1966. 474p.

The discussion covers the Coulomb–Maxwell electromagnetic interaction in vacuum including general electromagnetic theory, the retarded field of a particle in motion, and the use of higher potentials. The dynamics of a strongly accelerated point charge including theories proposed for the Lorentz–Abraham equation, properties of the Lorentz and Abraham equations, the constant force dependent only on time, the constant force dependent only on position, constant and uniform fields, diverse fields, and betatrons and synchrotrons is considered. The dynamics of a highly accelerated point charge is also covered including theory with absorber and retarded potentials, an example of a non-Maxwellian theory, theory with f(r) replacing $1/r^2$, and an example of a theory with discontinuous time. (J.F.P.)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 34511, 35213, 35214, 35461, 35490, 35546, and 35670.

35378 (AD-633426) A ONE-VELOCITY S_N COMPUTER CODE. Technical Report. Kesselman, R. (Picatinny Arsenal, Dover, N. J. Feltman Research Labs.). June 1966. 50p. (TR-3247). CFSTI.

A set of calculations on the angular and spatial distribution of monoenergetic neutrons in a uniform slab was made using the S_n method. The basic S_n technique is explained in detail. A FORTRAN II computer code for the IBM 7090 for the distribution of monoenergetic neutrons in plane geometry using the S_n approximation is presented. Absorption and isotropic elastic scattering are taken into account. Calculations were conducted to study the effect on the neutron distribution of varying the space mesh size and the number of angular intervals. The results indicated that an S_8 approximation and a space mesh increment of less than or equal to 0.2 mean free path will give sufficiently good accuracy for calculation of the flux. Graphs and tables showing the variation of flux, inverse relaxation distance, and linear extrapolation distance with c (the ratio of the scattering to the total macroscopic cross sections) are presented. (auth)

35379 (AE-284) FINITE-GEOMETRY AND POLARIZED MULTIPLE-SCATTERING CORRECTIONS OF EXPERIMENTAL FAST-NEUTRON POLARIZATION DATA BY MEANS OF MONTE CARLO METHODS. Aspelund, O.; Gustafsson, B. (Aktiebolaget Atomenergi, Stockholm (Sweden)). June 1967. 70p. Dep.

After an introductory discussion of various methods for correction of experimental left–right ratios for polarized multiple-scattering and finite-geometry effects, necessary and sufficient formulas for consistent tracking of polarization effects in successive scattering orders are derived. The simplifying assumptions are then made that the scattering is purely elastic and nuclear and that in the description of the kinematics of the arbitrary scattering μ only one triple-parameter (the so-called spin rotation parameter $\beta(\mu)$) is required. Based upon these formulas, a general discussion of the importance of the correct inclusion of polarization effects in any scattering order is presented. Special attention is then paid to the question of depolarization of an already polarized beam. Subsequently, the formulas are incorporated in the comprehensive Monte Carlo program MULTPOL, which was designed to correctly account for finite-geometry effects in the sense that both the scattering sample and the detectors (both having cylindrical shapes) are objects of finite dimensions located at finite distances from each other and from the source of polarized fast-neutrons. A special feature of MULTPOL is the application of the method of correlated sampling for reduction of the standard deviations of the results of the simulated experiment. Typical data of performance of MULTPOL were obtained by the application of this program to the correction of experimental polarization data observed in n + ^{12}C elastic scattering between 1 and 2 MeV. Finally, in the concluding remarks the possible modification of MULTPOL to other experimental geometries is briefly discussed. (auth)

35380 (AECL–2709) ONE-VELOCITY NEUTRON FLUX DISTRIBUTION IN A CYLINDRICAL CELL. Kushneriuk, S. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1967. 36p. (CRT–1258). Dep. CFSTI. CAN $1.00.

Formulas are presented which permit a fairly accurate description of the neutron flux distribution in the one-velocity approximation in a cylindrical lattice cell. The formulas are based on the solution of the integral equation for the neutron flux in a cell which is of infinite extent and which consists of a "thick" medium which scatters neutrons isotropically and contains a uniform distribution of isotropic neutron sources and an axially located neutron absorbing rod and sheath. Specifically, some of the formulas given are for the extrapolation length, the ratio of the surface-to-average flux in the rod, and the "transient" functions associated with the description of the neutron flux distribution near the absorbing rod. The formulas are derived from considerations of the neutron transport equation in the one-velocity limit. Motivation for their derivation has to a considerable extent come from thermalization studies in thermal reactor cells where, in many instances, the one-velocity results are directly applicable. (auth) (CANADA)

35381 (ANL–7320, pp 16-21) FISSION CROSS-SECTION MEASUREMENTS OF ^{233}U, ^{235}U, ^{239}Pu, AND ^{241}Pu IN THE ENERGY RANGE FROM 1 TO 25 keV. James, G. D. (Atomic Energy Research Establishment, Harwell (England)).

Fission cross-section measurements have been carried out, by time-of-flight experiment, over the energy range from 1 eV to 25 keV for the nuclides ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu. The data obtained from 1 keV to 25 keV are presented and compared with existing data. It is shown that in this energy range the available data for ^{235}U are in good agreement and that the data for ^{233}U and ^{239}Pu agree fairly well. A list of 19 references is included. (auth)

35382 (ANL–7320, pp 27-30) THE AUTOMATED PREPARATION OF MULTIGROUP CROSS SECTIONS FOR FAST REACTOR ANALYSIS USING THE MC^2 CODE. O'Shea, D. M. (Combustion Engineering, Inc., Windsor, Conn.); Toppel, B. J.; Rago, A. L. (Argonne National Lab., Ill.).

The fully automated multigroup-cross-section preparation program MC^2 makes use of an evaluated nuclear data file (ENDF) as its basic input. The degree to which the ENDF data is initially subdivided preparatory to averaging is variable in MC^2. Cross sections in the resolved resonance region are calculated through use of Doppler-broadened line shapes and include effects due to interference scattering and the influence of overlapping resonances in various isotopes in the mixture. Unresolved resonance cross sections are obtained by means of averages over suitable Porter-Thomas distributions of the neutron and fission widths. Quantities which are smoothly varying with respect to energy are represented in the library by coordinates of end points of linear segments taken from ln E vs ln σ, ln E vs σ, or E vs σ graphs. Inelastic scattering and $n,2n$ matrices are computed from excitation functions for individual levels and by use of a nuclear evaporation model above the resolved region. Elastic-scattering cross sections are computed from Legendre coefficients for the expansions of the angular distribution data for scattering. A fundamental-mode-weighting spectrum for the problem composition may be obtained for either the P1 or the consistent B1 or P1 approximations. Iteration on buckling to criticality is optional. The generated spectrum is used to contract the fine-group cross sections to a specified set of broad-group multigroup cross sections. (auth)

35383 (ANL–7320, pp 47-53) PRESENTATION OF THE MULTIGROUP CROSS-SECTION SET PREPARED AT CADARACHE. Ravier, J.; Chaumont, J. M. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires).

A set of multigroup cross sections has been developed at Cadarache. After a short review of the sources of basic nuclear data, the report explains how the multigroup set was developed and how it is currently used; then a brief comparison between experimental and calculated results is given. A list of 22 references is included. (auth)

35384 (ANL–7320, pp 88-106) OPTIMISATION OF NEUTRON CROSS-SECTION DATA ADJUSTMENTS TO GIVE AGREEMENT WITH EXPERIMENTAL CRITICAL SIZES. Hemment, Pamela C. E.; Pendlebury, E. D. (Atomic Weapons Research Establishment, Aldermaston (England)).

A method is described which enables adjustments of group cross sections to be calculated in an optimum way to fit experimental critical sizes when resonance self-shielding is not important. The method uses a least-squares fitting procedure and takes into account the experimental uncertainties on the cross-section data and the critical sizes. It is fully mechanized for use with the IBM-7030 and has been shown to work satisfactorily. The machine programs involved are briefly described and an account given of some results obtained. The extension of the method to take into account other integral data, such as spectra and reaction-rate measurements, in critical systems is discussed along with a way of dealing with resonance self-shielding. A list of 17 references is included. (auth)

35385 (ANL–7328) ON THE STRUCTURE OF THE ISOTROPIC TRANSPORT OPERATORS IN THREE INDEPENDENT SPACE VARIABLES. Bareiss, Erwin H.; Abu-Shumays, Ibrahim K. (Argonne National Lab., Ill.). May 1967. Contract W-31-109-eng-38. 68p. Dep. CFSTI.

Based on the idea of separation of variables, a spectral theory for the three-dimensional, stationary isotropic transport operator is presented in a vector space of complex-valued Borel functions resulting in continuous sets of regular and generalized eigenfunctions. Because of the non-self-adjoint nature of this operator, the results could not be anticipated intuitively from the known decomposition of this operator in the special case of plane geometry. The results obtained indicate a promising new approach to the analytic solution of the linear transport equation in higher space dimensions. Examples are given for slab geometry with and without axial symmetry, spherical symmetry, and cylindrical symmetry. (auth)

35386 (COO-1546-4) LEMA: A PROGRAM FOR CALCULATING NEUTRON CROSS SECTIONS WITH THE R-MATRIX FORMALISM AND WITH THE COMPLEX POLE EXPANSION OF THE COLLISION MATRIX. Adler, D. B.; Adler, F. T. (Illinois Univ., Urbana. Dept. of Physics). Mar. 1967. Contract AT(11-1)-1546. 106p. Dep. CFSTI.

The program LEMA calculates neutron cross sections in fissionable elements with the alternate approaches of the Wigner level matrix and of the generalized Kapur-Peierls expansion using the complex poles of the collision matrix. The calculation proceeds from a given set of R-matrix parameters, and the complex eigenvalues of the level matrix are hence derived. Two alternate evaluations of the cross section curves are provided, and parameters for the multilevel expansion are produced. Two FORTRAN II versions of LEMA and a preliminary FORTRAN IV version are given. As an illustration of the potential uses of these programs, preliminary results of calculations of interference effects in closely spaced resonances are presented. (auth)

35387 (COO-1546-5) TANDEM: A PROGRAM FOR THE TWO-FOLD LEAST-SQUARES ANALYSIS OF CAPTURE AND FISSION CROSS SECTIONS WITH THE MULTILEVEL EXPANSION. Technical Report No. 5. Adler, D. B. (Illinois Univ., Urbana. Dept. of Physics). Mar. 1967. 63p. Dep. CFSTI.

The program TANDEM was developed for the simultaneous fitting of capture and fission cross sections in the fissile elements, using the multilevel expansion. The version presented is written in FORTRAN II and is operable on the IBM 7094 of the University of Illinois. This program consists of a combination of subroutines which at a later stage could be utilized to include the fitting of transmission data. This generalization of the program could be best accomplished using a larger computer such as an IBM 360 system. Nonlinear iterations on the values of the resonance energies and half-widths are executed by the program subject to flexible numerical tests and constraints which are introduced to enhance the convergence of the fitting process. The present formulation of the constraints attempts to utilize both the physical properties of the parameters which are involved in the fitting process, and the numerical experience gained with the preliminary use of the code. (auth)

35388 (GA-7898) INTEGRAL NEUTRON THERMALIZATION. Quarterly Progress Report for the Period Ending March 31, 1967. Beyster, J. R.; Antunez, H. M.; Borgonovi, G.; (and others) (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Apr. 4, 1967. Contract AT(04-3)-167. 115p. Dep. CFSTI.

Includes Appendix, GA-7674.

URANIUM-238—neutron diffusion in spheres of, fast, (E/T)
NEUTRONS, FAST—diffusion in uranium-238 spheres, (E/T)
NEUTRONS—diffusion in uranium-238 slabs at 6.7 eV, computer calculations of
URANIUM-238—neutron diffusion in slabs of, computer calculations for 6.7-eV
BENZENE—neutron spectra in, computer calculations of thermal
NEUTRONS, THERMAL—spectra in benzene and biphenyl, computer calculations of
BIPHENYL—for, neutron spectra in, computer calculations of thermal (S.F.L.)

35389 (GA-7898, App.) SLOW NEUTRON SCATTERING AND THERMALIZATION BY BENZENE. Sprevak, D.; Koppel, J. U. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). 27p. (GA-7674).

Calculations are presented for the neutron double differential scattering cross section, the single differential scattering cross section, the total cross section, and the average of the cosine of the scattering angle for benzene. Results are compared with previous calculations and with experimental data. (S.F.L.)

35390 (KAPL-P-3340) NEUTRON ABSORPTION RATE PREDICTIONS FOR MATERIALS WITH ANISOTROPIC EFFECTIVE MACROSCOPIC CROSS SECTIONS. Kurey, T. J.; Kopp, H. J. (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 18p. (CONF-670602-19). Dep. CFSTI.

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif.

The effect of anisotropy of the microscopic self-shielding factors on the time-dependent nuclear properties of core elements was studied using a one-group transport equation that includes angular-dependent effective macroscopic cross sections. Calculations were performed for an array of poison elements situated in a fuel region, assuming isotropic macroscopic absorption and scattering cross sections for the fuel regions and an anisotropic effective macroscopic cross section for the absorber region. (D.C.W.)

35391 (NP-16854) CALIBRATION OF A RADIUM (α,n) BERYLLIUM NEUTRON SOURCE. Louwrier, Pieter Willem Fredrik (Amsterdam Univ. (Netherlands)). 1966. 88p. Dep. Thesis.

The absolute yield of the Ra–Be source was measured by means of the manganese sulfate bath method. The induced ^{56}Mn activity of the solution was measured by means of three Geiger–Mueller counters, which were placed in the solution after the irradiation. The efficiency of these counters was determined by addition to the solution of samples of ^{56}Mn of known activity. This activity was calibrated by $4\pi\beta-\gamma$ coincidence measurements. To analyze the composition of the solution, a special type of activation analysis was used. This method makes possible the determination of the main component of a solution with a good accuracy in the presence of impurities of various kinds. Another type of activation analysis has been used to measure the influence of the cross section of the impurities present in the solution. The measurement of the correction due to the resonance absorption in manganese yielded a value for the resonance integral of 15.6 ± 1.9 barns, which is in agreement with recent publications. The escape of neutrons from the cylindrical tank was determined by calibrating the source in three tanks with increasing diameter and height. In addition the escaping neutrons were measured by means of a BF_3 counter, which was surrounded by a paraffin moderator. The absorption of neutrons in the source was determined by placing cylindrical cadmium cavities of different size around the source. The absorption is found by comparison of the activity induced in the manganese sulfate solution under these circumstances with the activity resulting from the bare source. The result is in agreement with the value found by variation of the macroscopic absorption cross-section of the source by means of Ag, Au, and Cd covers. In order to obtain an independent value for the neutron output of the source, a solution of sodium acetate was used instead of manganese sulfate. The advantages of this method are partially undone by the uncertainty in the thermal neutron absorption cross section of Na. In this case the escape of neutrons from the tank and the absorption of neutrons in the source were deduced from the corresponding values of the manganese sulfate solution. The correction due to fast neutron capture by O and S in the solutions was calculated by making use of the available cross-section data. The neutron output of the Ra–Be source was determined as Q = $(1.505 \pm 0.010) \times 10^6$ neutrons per second on June 1, 1964. Intercomparison with the neutron source of the National Research Council results in a neutron output for this source as: $Q_{NRC\text{-}BIPM} = (3.191 \pm 0.046) \times 10^6$ neutrons per second on June 1, 1964. A review of the literature concerning neutron sources and neutron source calibrations and a survey of the cross sections and half lives are given. (auth)

35392 (ORNL-4090) MEASUREMENTS AND SINGLE-VELOCITY CALCULATIONS OF DIFFERENTIAL ANGULAR THERMAL-NEUTRON ALBEDOS FOR CONCRETE. Maerker, R. E.; Muckenthaler, F. J. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 54p. Dep. CFSTI.

Measurements and single-velocity Monte Carlo calculations were performed to determine the differential angular thermal-neutron albedos for a reinforced concrete from monodirectional beams of incident thermal neutrons. Preliminary calculations using a statistical estimation technique indicate up to 50 scatterings should be followed for each neutron in order to produce good estimates of the differential albedos, and up to 100 scatterings to produce good estimates of the capture gamma-ray differential dose albedos. Deviation between experiment and calculation can be reduced to an average of 5.1% for 72 points of comparison if an anisotropic scattering law for water deduced from earlier Argonne National Laboratory measurements is assumed. (auth)

35393 (UCRL-50259) TRANSMISSION OF 14-MeV NEUTRONS IN LIQUID NITROGEN. Heusinkveld, Myron (California Univ., Livermore. Lawrence Radiation Lab.). June 9, 1967. Contract W-7405-eng-48. 23p. Dep. CFSTI.

The range of neutrons from a 14-MeV neutron source in liquid nitrogen was measured with various neutron detectors. The distance over which the flux of high-energy neutrons is attenuated by a factor of e was measured to be 36 ± 2 cm. Some results are also presented for lower-energy neutrons. (auth)

35394 (UJV-1720) VLIV DOBY LETU NEUTRONU NA "ROZPADOVOU" KONSTANTU PRI MERENI DIFUSNICH KONSTANT IMPULSNI METODOU. (Time-of-Flight Effect of Neutrons on Decay Constant in the Diffusion Measurements by Pulse Method). Cervena, J.; Bayer, R.; Schaeferlingova, W. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Feb. 1967. 47p. (In Czech). Dep.

An analysis of the time-of-flight effect of neutrons escaping from a moderator on the measured decay constant α in neutron pulse experiments is given. It is shown that this effect depends

on the detector distance from the moderator and on the geometric buckling β^2 and that it substantially modifies measured values of the decay constant. The deviation of α is different for different types of moderators, other circumstances unchanged, and represents 22% for light water and 32% for solid diphenyl at the detector to moderator distance of 11.75 cm and $\beta^2 = 0.80$ cm^{-2}. From these results the conclusion is drawn that in pulse experiments with far-off detectors either the range of bucklings used must be reduced and/or due corrections to measured α values must be introduced. (auth)

35395 (USNRDL-TR-67-57) NEUTRON ENERGY SPECTRUM: A CLASSICAL DERIVATION. Hoffman, D. (Naval Radiological Defense Lab., San Francisco, Calif.). May 23, 1967. 38p. CFSTI.

The epithermal neutron energy spectrum is derived as a function of radial distance from a point isotropic monoenergetic neutron emitter in an infinite homogeneous scattering and absorbing medium. The derivation uses Condon and Breit's neutron energy spectrum as a function of number of collisions and Chandrasekhar's general solution to the problem of random flights. (auth)

35396 USE OF A CALCITE CRYSTAL AS A NEUTRON MONOCHROMATOR. Manas Diaz, L.; Enriquez de Salamanca, M.; Cruz Paredes, M. An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 211-16(July-Aug. 1967). (In Spanish).

A calcite ($CaCO_3$) single crystal was studied in order to use it as a neutron monochromator. Primarily, the crystallographic planes belonging to the zones [001] and [$\bar{1}$01] were determined as well as their interplanar distances and structure factors. Results for the structure factors corresponding to planes (140), (130), (120), (230), and (1$\bar{1}$0) are at variance with previous values quoted in the literature. (auth)

35397 FISSION NEUTRON ATTENUATION AND GAMMA-RAY BUILDUP FACTORS FOR LITHIUM HYDRIDE. Kam, Francis B. K.; Clark, Francis H. S. (Oak Ridge National Lab., Tenn.). Nucl. Appl., 3: 433-5(July 1967). (ORNL-P-2776).

A fission-spectrum neutron dose-rate attenuation curve was computed by the Monte Carlo method for lithium hydride penetrations up to 67.5 g/cm^2. Gamma-ray exposure dose buildup factors were computed for lithium hydride using the moments method. Discrete gamma-ray source energies in the range from 0.5 to 10 MeV were used, and calculations were made out to 20 mean free paths (at source energy). (auth)

35398 EXPERIMENTAL EXAMINATION OF THE MICRODYNAMICS OF CONDENSED SYSTEMS BY NEUTRONS. Bata, Lajos (Central Inst. of Physical Research, Budapest). Magy. Fiz. Foly., 15: No. 1, 1-48(1967). (In Hungarian).

The maximum of the energy distribution of neutrons leaving the beamhole of a thermal reactor is about 0.0253 eV, with an associated wavelength of 1.81 Å; thus, the energy and frequency of thermal neutrons agree with those of condensed systems. Therefore, such neutrons may be used for determining the properties of solids and liquids. This method was used for the following studies: examination of the rotational states of molecules; diffusion of atoms and molecules; frequency spectra in solids and liquids; determination of the phonon dispersion in single crystals; determination of the dispersion curve of spin waves in ferromagnetic and antiferromagnetic materials, and examination of the line width, time of life and anharmonic effects. The experimental work involved the application of a monoenergetic neutron beam on the specimen, followed by the measurement of the scattered neutron distribution or of the characteristic parameters of the material. The apparatus used included a rotating chopper, a curved- or straight-slit chopper combined with a polycrystalline neutron filter, a triaxial crystal spectrometer, a rotating-crystal time-of-flight spectrometer, a beryllium detector and various hybrid devices. In most cases, a thermal reactor in steady-state operation served as the neutron source. (TTT)

35399 EXTRAPOLATION DISTANCE FOR ANISOTROPIC SCATTERING. Lois, Lambros; Goldstein, Herbert (Columbia Univ., New York). Nucl. Sci. Eng., 29: 148-9(July 1967).

The Milne problem was simulated as slab geometry, and the extrapolation lengths were calculated for three one-parameter representations of the scattering angular distribution using various absorption-to-scattering ratios. (D.C.W.)

35400 TRANSIENT SPECTRA IN BERYLLIUM. Ghatak, A. K. (Indian Inst. of Tech., New Delhi); Goyal, I. C.; Kothari, L. S. Nucl. Sci. Eng., 29: 149-51(July 1967).

The time-dependent neutron spectra in beryllium, following a fast neutron burst, were calculated using multigroup diffusion theory. The approach to equilibrium of the mean energy and mean velocity of neutrons inside the assembly was also determined. (D.C.W.)

35401 DENSITY TRANSFORMATIONS FOR TIME-DEPENDENT RADIATION TRANSPORT PROBLEMS. Zerby, Clayton D. (Union Carbide Corp., White Plains, N. Y.). Nucl. Sci. Eng., 29: 151-3(July 1967).

The transport of radiation from nuclear weapons through the atmosphere is considered with emphasis on the transformation of data to apply at different air densities. The required density transformations are derived for a step-function source and a delta-function source. (D.C.W.)

35402 CONTINUOUS EIGENVALUE SPECTRUM OF THE NEUTRON-WAVE EXPERIMENT. Duderstadt, J. J. (California Inst. of Tech., Pasadena). Nucl. Sci. Eng., 29: 156-7(July 1967).

The eigenvalue problem associated with plane-wave solutions of the general velocity-dependent Boltzmann equation is studied. It is shown that if the scattering operators are not compact, an additional continuous spectrum is obtained. (D.C.W.)

35403 INVARIANT IMBEDDING AND POLYENERGETIC NEUTRON TRANSPORT THEORY. PART I. THEORY. Mockel, Andre (Brookhaven National Lab., Upton, N. Y. Univ. Libre, Brussels). Contract AT(30-2)-Gen-16. Nucl. Sci. Eng., 29: 43-50(July 1967). (BNL-10211).

Invariant imbedding is applied to compute the energy-dependent, time-dependent transmission and reflection of neutrons in slab geometry. A set of "characteristic functions" (which are a generalization of Chandrasekhar's X- and Y-functions) can be defined when the scattering kernel is degenerated. A computational scheme is outlined which makes use of these functions to obtain the time decay constant, the time-asymptotic leakage flux, and, for a steady-state case, the thermal utilization factor for a heterogeneous system. (auth)

35404 INVARIANT IMBEDDING AND POLYENERGETIC NEUTRON TRANSPORT THEORY. PART II. NUMERICAL RESULTS. Mockel, Andre (Univ. Libre, Brussels. Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Nucl. Sci. Eng., 29: 51-7(July 1967). (BNL-10604).

Numerical results for the time asymptotic neutron flux in a pulsed experiment, and for the thermal utilization factor in an infinite slab lattice, are derived using invariant imbedding. An isotropic separable kernel is assumed. It is shown that, although the neutron spectrum is strongly dependent on the shape of the kernel and thus can not hope to be accurately predicted with a separable kernel, the qualitative behavior is in good agreement with previous computations. Moreover, some other features (the angular dependence of the flux, and the thermal utilization factor) are shown to have less dependence on the thermalization model, and are thus accurately predicted. (auth)

Nuclear Properties and Reactions, A≤ 5

Refer also to abstracts 34220 and 35432.

35405 (AD-650970) ^{3}He(^{3}He,t)^{3}P AT 44 MeV. Tombrello, T. A.; Slobodrian, R. J. (California Inst. of Tech., Pasadena. California Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1967. Contract Nonr-220(47). 10p. CFSTI.

Triton spectra from the reaction ^{3}He(^{3}He,t)3p were measured at a bombarding energy of 44 MeV for laboratory angles between 6 and 25°. These spectra are quite featureless and show no indication of either a 3p final-state interaction or of a strong sequential decay mode. (auth) (TAB)

35406 (ANL-7312) PHYSICS DIVISION SUMMARY REPORT, JANUARY-MARCH 1967. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 90p. Dep. CFSTI.

Short reports on highlights of current research, abstracts or short summaries of oral presentations at meetings, abstracts of papers recently accepted for publication, and publication notices of papers appearing in recent journals and books are included. (C.E.S.)

35407 REACTION D(d,n)^{3}He WITH POLARIZED DEUTERONS AT 460 keV. Paetz gen. Schieck, H.; Huber, P.; Petitjean, C.; Rudin, H.; Striebel, H. R. (Univ., Basel). Helv. Phys. Acta, 40: 401-22(July 1, 1967). (In German).

The Basel source of polarized deuterons was improved by introducing suitable r-f transitions in the atomic beam together with its ionization in a strong magnetic field at 500 G. Tensor polarization values up to ±0.70 and a vector polarization of the deuteron beam up to −0.46 were obtained. A Wien filter allows turning the alignment axis by spin precession into any desired

direction and simultaneously analyzes the ions of the beam before acceleration. With this device the four independent components of the polarization efficiency of the D(d,n)^{3}He reaction have been measured at a mean deuteron energy of $\overline{E_d}$ = 460 keV. The results reveal some deviations from the theoretical predictions of Rook and Goldfarb. The angular dependence of the rather large vector component D(ϑ) shows that triplet-singlet spin transitions take place with high probability. Such transitions are allowed within the assumptions of the Goldfarb theory, if an(L · S) force acts between the nucleons. Finally the results of the D(d,n)^{3}He and the D(d,p)^{3}He reactions are compared. (auth)

35408 EXCLUSION PRINCIPLE AND THE NEUTRON–ALPHA EQUIVALENT POTENTIAL. Swan, Peter (Laval Univ., Quebec). Phys. Rev. Lett., 19: 245-7(July 31, 1967).

Because of the exclusion principle, the phase/binding energy-equivalent n-α potential in the S state should have a repulsive core or Pauli barrier $V(r \to 0) \to (\hbar^2/2\mu)6/r^2$. A distorted inverse-square barrier wave approximation is used to deduce from experimental phases an entirely repulsive, l = 0 n-α potential. (auth)

35409 ^{3}He + p ELASTIC SCATTERING FROM 12.6 TO 15.4 MeV. Donovan, P. F. (Bell Telephone Labs., Murray Hill, N. J.); Kane, J. V.; Mollenauer, J. F.; Boyd, D.; Parker, P. D.; Zupancic, C. Contract AT(30-2)-Gen-16. Phys. Rev., 158: 973-6(June 20, 1967). (BNL–10815).

The elastic scattering of protons from ^{3}He was studied in a search for a narrow level in ^{4}Li reported to lie about 10.6 MeV above ^{3}He + p. Data were obtained at laboratory angles of 120 and 150° at proton energies from 12.6 to 15.4 MeV in 100-keV steps and from 13.84 to 14.74 MeV in overlapping 10-keV steps. Measurements were made relative to the elastic scattering of protons from ^{4}He by using a mixture of ^{3}He and ^{4}He in the gas target. The ratio of the ^{3}He(p,p) yield to the ^{4}He(p,p) yield was smooth to ±0.75% over the entire energy range. In this region an experimental upper limit of 10^{-5} times the Wigner limit was determined for the reduced width of any narrow singlet s-wave resonance. (auth)

35410 POTENTIAL MODEL CALCULATION OF PROTON–PROTON BREMSSTRAHLUNG. Sobel, M. I. (City Univ. of New York, Brooklyn); Cromer, A. H. Phys. Rev., 158: 1157-60 (June 20, 1967).

The cross section $d\sigma/d\Omega_1 d\Omega_2 d\epsilon_\gamma$ for proton-proton bremsstrahlung is calculated for various energies and geometries, using the Yale potential and the Hamada–Johnston potential. The results are compared with the experimental data at 200, 158, and 48 MeV. Good agreement is obtained with the 158-MeV data, though the calculated cross sections are somewhat too large in the forward direction (of the scattered photon) and somewhat too small in the backward direction. The integrated cross section $d\sigma/d\Omega_1 d\Omega_2$ is in fair agreement with the data at 200 MeV, but at 48 MeV the experimental cross section is three to four times smaller than the calculated values. This could be because of the acceptance of non-coplanar events in the experiment. (auth)

35411 ATOMIC MASSES FROM ACCURATE MEASUREMENTS OF Q VALUES. O'Donnell, F. H.; Browne, C. P. (Univ. of Notre Dame, Ind.). Phys. Rev., 158: 957-69(June 20, 1967).

Precision measurements were made of the ground-state Q-values of the following nuclear reactions: D(d,p)T, ^{12}C(d,p)^{13}C, D(^{3}He,p)^{4}He, ^{10}B(^{3}He,p)^{12}C, ^{9}Be(^{3}He,p)^{11}B, ^{11}B(^{3}He,p)^{13}C, ^{12}C(^{3}He,p)^{14}N, ^{11}B(^{3}He,d)^{12}C, ^{11}B(d,α)^{9}Be, ^{10}B(d,α)^{8}Be, ^{9}Be(p,d)^{8}Be, ^{9}Be(p,α)^{6}Li, ^{9}Be(d,t)^{8}Be, ^{13}C(d,t)^{12}C, and ^{10}B(α,p)^{12}C. There were 164 separate measurements made on these reactions. The standard deviations of the mean and a best estimate of error based on estimates of possible systematic errors were calculated. These errors ranged from ±0.2 to ±1.9 keV for the standard deviations and from ±0.6 to 5.7 keV for the best estimates of error. Analysis of the direct measurements and reaction cycles between the measured reactions yielded best values for the D(d,p)T and the D(^{3}He,p)^{4}He Q-values. The best values and the mass excesses of H and D and the T-^{3}He mass difference as found in the 1964 Mass Table were used to calculate the ^{3}He, T, and ^{4}He mass excesses. The mass excesses of ^{6}Li, ^{8}Be, ^{9}Be, ^{10}B, ^{11}B, ^{12}C, and ^{14}N were then calculated from the Q-value measurements. Errors were calculated for these mass excesses based upon the standard deviations of the measured Q-values and upon the estimates of possible systematic uncertainties. Analysis of consistency factors indicates that the actual errors lie between these two error estimates. These results constitute the most accurate systematic determination of these masses from Q-value data. (auth)

35412 THE REACTION D(d,p)^{3}H WITH POLARIZED DEUTERONS. Petitjean, Cl.; Huber, P.; Paetz gen. Schieck, H.; Striebel, H. R. (Univ., Basel). Helv. Phys. Acta, 40: 423-35 (July 1, 1967). (In German).

With the Basel source of polarized deuterons the polarization efficiency vector and tensor of the D(d,p)^{3}H reaction were measured at 460 keV mean deuteron energy. Using a D_2-gas target of 80 keV thickness the protons were observed in two reaction planes with eight surface barrier detectors at angles between 0° and 155°. The arrangement of targets and detectors and the evaluation method are described. The four independent components of the polarization efficiency D(ϑ), $D_{33}(\vartheta)$, $D_{11}(\vartheta) - D_{22}(\vartheta)$ and $D_{13}(\vartheta)$ were fitted by Legendre polynomials. It is shown that the fits include more terms than predicted by the theory of Rook and Goldfarb. (auth)

35413 K^- CAPTURE BY ^{4}He AND KN s-INTERACTION. Kohmura, T. (Tokyo Univ. of Education). Nucl. Phys., B2: 225-33 (1967).

K^- capture rate by ^{4}He is calculated by using K^-N s-interaction. Anti-symmetrization of nuclear wave functions is considered. The obtained capture rate from the 2p orbit is $(2.4 \pm 0.4) \times 10^{13}$ sec^{-1}, which is constant with its experimental value. Hyperons produced by K^- capture from the 2p orbit are, however, emitted from the nucleus. Production of hypernuclei $^4_\Lambda$He and $^4_\Lambda$H results from the capture of K^- meson in the 1s orbit. The calculation also shows that the hypernucleus production processes are 2.8% of all K^- capture events. Agreement of these results with the experiment shows that the KN s-interaction is effective even in K^- capture by the nucleus. (auth)

35414 SEARCH FOR RARE DECAY MODES OF HYDROGEN AND HELIUM HYPERNUCLEI. Gajewski, W. (Univ., Brussels); Mayeur, C.; Sacton, J.; Vilain, P.; Wilquet, G.; Davis, D. H.; Fletcher, E. R. Nucl. Phys., B2: 282-95(1967).

An objective approach to the identification of rare or previously unknown hypernuclear decay modes is presented. A search for definite examples of unusual hydrogen and helium hypernuclei using this method has been unsuccessful, except for those of the (π^-, ^{3}H ^{4}He) decay mode of $^4_\Lambda$He. (auth)

35415 THE SCATTERING OF 1.0- AND 2.4-MeV POLARIZED NEUTRONS FROM HELIUM. Sawers, James Richard Jr. Durham, N. C., Duke Univ., 1966. 164p.

Thesis.

Precision angular distributions of the asymmetry in the scattering of 1.0 and 2.4 MeV polarized neutrons from He were determined. The reactions ^{7}Li(p,n)^{7}Be and ^{12}C(d,n)^{13}N served as neutron sources and target thicknesses of 46 and 175 keV respectively were used. Analyzing angles ranged from 30 to 140° in 10° increments. A spin precession solenoid was employed and the He was contained in a high pressure scintillation cell. Neutrons scattered through the desired scattering angle were detected with plastic scintillators. Recorded backgrounds were minimized by accepting only He recoil counts, which satisfied specific energy requirements and which were coincident with the neutrons detected in the plastic scintillators. A Monte Carlo program employing the formalism of Wolfenstein, was written for calculating the effects on the observed asymmetry of multiple scattering in the He cell. Results from this code also allowed the data to be corrected for the effects of the finite geometry of the cell and the neutron detectors. It is demonstrated that polarization data alone are sufficient to accurately determine the scattering phase shifts at 2.44 MeV. Here the phase shift values were found to be –37.2 ± 2.4, 21.2 ± 0.5, and 121.6 ± 0.5° for the δ_T^+, δ_T^-, and δ_T^+ phase shifts respectively. Hard sphere calculations employing the s-wave phase shift give a hard sphere radius of 2.42 ± 0.13 fm which is consistent with the values recently obtained by others from both n-α and p-α scattering data. D-waves were not found to be necessary. Below the $P_{\frac{3}{2}}$ resonance at 1.3 MeV, the phase shifts were not as sensitive to the measured relative asymmetries. It appears that additional cross-section data will be required to accurately determine the phase shifts in this energy region. Since it was observed that at 1.0 MeV equally good fits to the present data could be obtained with values of δ_T^+ differing by as much as 15°, the hard sphere formalism, in conjunction with the scattering radius obtained at 2.4 MeV, was used to fix the s-wave phase shift at –24.5° ± 1.5°. The fit to the data then required that $\delta_T^+ = 4.4 \pm 1.0$ and $\delta_T^- = 61.2 \pm 4.5$. Examination of the determined phase shifts shows s-wave phase shifts to be smaller than the commonly accepted ones of Dodder, Gammel, and Seagrave (DGS). At both energies the δ_T^+ was in excellent agreement with DGS although δ_T^- appeared 1.6° below DGS at 1.0 MeV and 2.8° high at 2.44 MeV. In addition the earlier asymmetry data of May, Walter, and Barschall for n-He scattering at 2.0 MeV were corrected for the effects of multiple scattering and finite size and then were analyzed for phase shift determinations. For the May data, the angle at which the polarization crossed through zero was observed to be shifted toward back angles relative to the DGS prediction. This shift was also observed in the experiment at 2.44 MeV. By searching the δ's and P_1 it was found that one can limit the value of P_1 to –0.458 ± 0.006 for the re-

action $^{12}C(d,n)^{13}N$ for an incident deuteron energy of 2.82 MeV when the neutrons are observed at 25° (lab). A similar determination of the incident polarization in the reaction $^{7}Li(p,n)^{7}Be$ can be obtained when the s-wave phase shift is restricted to the hard sphere value. For an incident proton energy of 2.92 MeV and at a laboratory angle of 50° the neutron polarization was observed to be 0.304 ± 0.008. (Disser. Abstr.)

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Refer also to abstracts 34221, 34463, 35411, 35435, 35437, 35511, 35517, and 35526.

35416 (CEA-R-3124) ETUDE DE LA COINCIDENCE RAPIDE (n,He^3) EN REACTION (d,d). MESURES DE DIVERSES SECTIONS EFFICACES TOTALES. (Study of the Fast Coincidence (n,^{3}He) in (d,d) Reactions. Measurement of Various Total Cross Sections). Thibault, Claude (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1967. 63p. (In French). Dep.

Thesis. Submitted to Paris Univ., Orsay, France.

The neutron total cross sections of ^{27}Al, ^{9}Be, ^{52}Cr, ^{59}Co, ^{69}Ga, ^{58}Ni, ^{238}U, and ^{51}V were measured in the neutron energy range of 3 MeV using the associated-particle method. A CsI(Tl) scintillator coupled to a photomultiplier was used to detect the charged particles. The kinematics of the reactions D(d,p)T and D(d,n)^{3}He are studied, together with the shape of the time spectra. (D.C.W.)

35417 ELASTIC SCATTERING OF 24-MeV α PARTICLES BY ^{12}C. Aguilar, J.; de la Rubia, J.; Fernandez Pineda, C. An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 217-20(July–Aug. 1967). (In Spanish).

Data on the angular distribution for the elastic scattering of 24-MeV alpha particles by ^{12}C within the angular interval 15 to 170° are presented. The study was made with the nuclear emulsion technique. The backward peaks show the existence of resonances predicted by a type of compound elastic mechanism in alpha scattering from nuclei such as ^{12}C with an alpha cluster structure. (auth)

35418 ON THE APPLICATION OF THE HONDA–KUDO–UI THEORY TO THE ELASTIC SCATTERING OF α PARTICLES BY ^{12}C. Bolta, J. M.; Garcia, A.; Pascual, P.; Senent, F. (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 221-7(July–Aug. 1967).

The application of the theory of Honda–Kudo–Ui to the backward elastic scattering of α particles by ^{12}C is studied. The predictions of the theory are compared with some experimental data on angular distributions and excitation functions. (auth)

35419 EFFECT OF THE PAULI PRINCIPLE IN ^{16}O–^{16}O ELASTIC SCATTERING. Block, Barry (Univ. of California, San Diego, La Jolla); Malik, F. B. Phys. Rev. Lett., 19: 239-42 (July 31, 1967).

Striking regularities were previously seen in the 90° differential cross section for ^{16}O–^{16}O elastic scattering at 17 to 35 MeV (cms). An explanation in terms of the Pauli principle is discussed. An effective potential comprising the sum of the Pauli-principle-dominated nuclear potential and a potential barrier which is a sum of the Coulomb and centrifugal barriers at the nuclear surface is considered. It is shown that the cross section can be fitted up to 31 MeV using a one-dimensional model of such a potential. (D.C.W.)

35420 INELASTIC SCATTERING OF RELATIVISTIC ELECTRONS ON NUCLEI. Gul'karov, I. S.; Umarov, G. Ya. (Tashkent Polytechnic Inst.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 65-8(1966). (In Russian).

A nucleus can be converted into a discrete excited state upon colliding with a fast electron. The number of inelastically scattered electrons can be analyzed by a magnetic spectrometer and can be correlated with the energy of the scattered electrons. The excited nuclear levels are indicated by peaks on the experimental curve. By using the relations of relativistic kinematics, an expression for the energies of the scattered electrons is obtained, and the positions of the maxima are readily calculated. Values of the inelastically scattered electrons are calculated for a number of excited states of ^{9}Be (0, 1.70, 2.43, 6.80, and 11.30 MeV) at incident electron energies of 50, 100, 200, 300, 400, and 500 MeV for angles of 0 to 180°. The energies of the scattered electrons are determined with an accuracy of 1 keV. Analogous calculations have been published for ^{12}C. (TTT)

35421 ON THE CALCULATION OF THE TOTAL MUON CAPTURE RATES FOR ^{6}Li AND ^{7}Li. Lodder, A.; Jonker, C. C. (Vrije Univ., Amsterdam). Nucl. Phys., B2: 383-93(1967).

The semi-empirical method of Foldy and Walecka for calculating total muon capture rates for doubly magic nuclei turns out to be generally applicable for nuclei with isospin quantum numbers $(T,T_z) = (T,-T)$. $\Lambda^{\mu c}(^{6}Li)$ and $\Lambda^{\mu c}(^{7}Li)$ are calculated with this method. Comparison with experiment leads to the conclusion that the measured value for $\Lambda^{\mu c}(^{6}Li)$ is unreliable. (auth)

35422 STUDY OF THE (α,t) REACTION IN ^{19}F. Hansen, Luisa F.; Lutz, H. F.; Stelts, Marion L.; Vidal, Jose G.; Wesolowski, Jerome J. (Univ. of California, Livermore). Contract W-7405-eng-48. Phys. Rev., 158: 917-24(June 20, 1967). (UCRL-14892).

The reaction, $^{19}F(\alpha,t)^{20}Ne$ was studied at 28.5 MeV. Angular distributions and absolute cross sections were measured from 15 to 170° for transitions leading to the ground (0^+), 1.63-MeV (2^+), 4.25-MeV (4^+), and 4.97-MeV (2^-) states. The 5.63-MeV (3^-) and 5.80-MeV (1^-) levels were observed, but not resolved; this was also the case for the 7.02-MeV (4^-), 7.19-MeV (3^-), and 7.22-MeV (0^+) levels. The 6.75-MeV (0^+) level was barely excited in the reaction. The angular distributions of the tritons to all the final states in ^{20}Ne, with the possible exception of the 4.97-MeV level, show the characteristics of a stripping mechanism. The possibility of intermediate inelastic excitations in the stripping to the 4.25-MeV level is discussed. The angular distributions were fitted with a zero-range distorted-wave Born approximation, and ratios of spectroscopic factors were compared with the predictions of the Nilsson model and Harvey's SU(3) shell-model calculations for ^{20}Ne. (auth)

35423 LIFETIME OF THE 1.042-MeV STATE IN ^{18}F. Blaugrund, A. E.; Youngblood, D. H.; Morrison, G. C.; Segel, R. E. (Argonne National Lab., Ill.). Phys. Rev., 158: 893-7 (June 20, 1967).

The lifetime of the 1.042-MeV, T = 1 state in ^{18}F was measured by use of the attenuated-Doppler-shift method. Analysis of the measurements by use of the universal stopping cross section given by Lindhard, Scharff, and Schiott give a mean life $\tau = 0.4 \times 10^{-14}$ sec. The experimental lifetime agrees with the value calculated from the corresponding Gamow–Teller β transition according to a relation given by Kurath. The accuracy of the universal stopping cross section is discussed. (auth)

35424 STUDY OF CROSS-SECTION FLUCTUATIONS FOR $^{6}Li + ^{12}C$ REACTIONS. Dzubay, T. G. (Univ. of Minnesota, Minneapolis). Phys. Rev., 158: 977-83(June 20, 1967).

Differential cross-section measurements for $^{6}Li + ^{12}C$ reactions are presented in 100-keV steps between 2.4 and 8.5 MeV at 0° and in 200-keV steps between 3.4 and 7.4 MeV at 40° (lab). Fluctuations in the cross sections are observed at all energies, but they are superimposed upon a rapid rise in cross section for beam energies below 4 MeV due to the Coulomb barrier effects. Coulomb barrier effects are accounted for by calculating the average differential cross section from the Hauser–Feshbach formula in which the transmission coefficients are determined from an optical-model potential. The ratios of the observed-to-calculated cross sections fluctuate about an almost constant value. These ratios are analyzed in terms of the Ericson fluctuation theory from which the coherence width is estimated to be $\Gamma_0 = 250$ keV (cms). The average cross-section ratio for the $^{12}C(^{6}Li,\alpha_1)^{14}N$ reaction indicates a 30% violation of isobaric-spin conservation in the 3.4- to 6.0-MeV interval. (auth)

35425 NEUTRINO EXCITATION OF THE GIANT RESONANCE IN ^{12}C. Kelly, Francis J. (Naval Ordnance Lab., Silver Spring, Md. Catholic Univ. of America, Washington, D. C.); Ueberall, H. Phys. Rev., 158: 987-93(June 20, 1967).

The differential and total cross sections of the neutrino excitation of the giant resonance (gi. res.) in ^{12}C are calculated using the Brown one-particle–one-hole theory. It is found that the total cross section levels out at 1.5×10^{-39} cm^2 above 500 MeV. The $^{12}N_{gi.res.} \rightarrow {}^{11}C + p$ spectrum using Boeker's method is also calculated, because this decay can identify the neutrino reaction in a bubble chamber. To check the programs, muon-capture matrix elements for transitions to the $^{12}B_{gi.res.}$ state were recalculated, and it was found that some published numerical values should be changed. (auth)

35426 IS A $^{7}_{\Lambda}Li$ HYPERISOMER POSSIBLE? Pniewski, J. (Univ. of Warsaw. Inst. for Nuclear Research, Warsaw); Szymanski, Z.; Davis, D. H.; Sacton, J. Nucl. Phys., B2: 317-25(1967).

The possibility of the existence of an isomeric state of $^{7}_{\Lambda}Li$ is considered. The conclusion appears to depend crucially on the energy of the excited state $\frac{1}{2}^+$ of $^{7}_{\Lambda}Li$. If only the spin-dependent central Λ-N forces are taken into account to explain the splitting of the states in hypernuclei then different values of parameter Δ for different states have to be considered. Tensor and spin-orbit forces might contribute to the explanation of the apparent changes of Δ for different p-shell hypernuclei in their ground and excited states. (auth)

35427 PHOTOPRODUCTION OF CHARGED PIONS FROM ^{16}O. Devanathan, V. (Univ. of Virginia, Charlottesville); Rho, M.; Rao, K. Srinivasa; Nair, S. C. K. Contract AT(40-1)-2915. Nucl. Phys., B2: 329-41(1967). (ORO-2915-71).

The photoproduction of π^+ from $^{16}O(0^+, g.s.)$ leading to the four bound states $J^\pi = 0^-, 1^-, 2^-, 3^-$ in ^{16}N is studied by means of the transition amplitude obtained in impulse approximation. Ambiguity in the nuclear structure is eliminated by recognizing that the muon capture process to the same final states, $\mu^- + {}^{16}O(0^+) \rightarrow \nu_\mu + {}^{16}N(J^\pi, T = 1)$ involves similar matrix elements and by using the same wave functions which predict correctly the partial capture rates. It is found in comparing the results with available experimental data that there still remains a factor of two discrepancy which may be attributed to the uncertainty in the production amplitude itself. (auth)

35428 $^{14}N(n,d)^{13}C$, $^{14}N(n,t)^{12}C$, AND $^{15}N(n,d)^{14}C$ NEAR $E_n = 14$ MeV. Fessenden, P.; Maxson, D. R. (Brown Univ., Providence). Phys. Rev., 158: 948-56(June 20, 1967). (NYO-1082-3).

A triple-coincidence counter telescope consisting of two thin silicon surface-barrier dE/dx detectors (114 μ total thickness) and a CsI E detector was used with a pulse-multiplier particle-discrimination system to detect the charged particles emanating from nuclear reactions induced by 14.1- or 14.8-MeV neutrons. Angular distributions of the outgoing charged particles from the ground-state transitions of $^{14}N(n,d)^{13}C$ and $^{14}N(n,t)^{12}C$ were measured out to a center-of-mass angle of 100° for 14.1-MeV incident neutrons. The (n,d) distribution was fitted with two l = 1 theoretical curves calculated from the Butler and distorted-wave Born-approximation (DWBA) theories. The (n,t) results were fitted by two l = 2 curves calculated from the double-stripping theory of Newns and the diffraction theory of Dar, and were compared to previous results obtained for $^{12}C(^3He,p)^{14}N$. Charged particles corresponding to the excited-state transitions $^{14}N(n,d)^{13}C$ ($E_x = 3.68$ MeV) and $^{14}N(n,t)^{12}C$ ($E_x = 4.43$ MeV) were detected at forward angles. Angular distributions for the $^{15}N(n,d)^{14}C$ ($E_x = 0$) reaction were measured out to 60° for $E_n = 14.1$ and 14.8 MeV. The 14.8-MeV data were fitted with Butler and DWBA curves for l = 1, but the 14.1-MeV data were inconsistent with a pure-direct-reaction interpretation. The results agree with previous measurements on the inverse $^{14}C(d,n)^{15}N$ reaction and indicate that a compound-nucleus mechanism contributes strongly near 14.9 MeV of excitation in the ^{16}N compound nucleus. Absolute reduced widths θ^2 and spectroscopic factors C^2S were extracted from the fits to the $^{14,15}N(n,d)$ ($E_x = 0$) reactions. (auth)

35429 ON THE MECHANISM OF APPEARANCE OF PROTON POLARIZATION IN THE REACTION $^{12}C(d,p)^{13}C$ WITH E-1.06 TO 1.10 MeV. Khomyakov, G. K.; Skakun, N. A.; Strashinskii, A. G. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh., 12: 375-8(Mar. 1967). (In Russian).

Various ways of formation of polarized protons in the reaction $^{12}C(d,p)\ ^{13}C$ with a deuteron energy in the region of 1.06 to 1.10 MeV are considered. Data on the complete and differential cross section and polarization of protons are applied. A comparison of the experimental data with the theoretical expressions show that polarization arises mainly as a result of interference of the 11.23-MeV and 11.29-MeV resonances. $J^\pi = 2^+$ or $J^\pi = 3^+$ is then assigned to the 11.23-MeV level. Polarization can not be explained by the fact that the states of 11.06 and 11.29 MeV decay with $S' = 1$, since in this case change of polarization with energy should be different. (auth)

35430 MUON CAPTURE AND SUPERMULTIPLET SYMMETRY BREAKING IN ^{16}O. Walker, George Edward. Cleveland, Case Inst. of Tech., 1966. 186p.

Thesis.

The validity of assuming the equality of the unretarded dipole muon capture matrix elements, $(M_7^2)_{U.D.}$, $(M_5^2)_{U.D.}$, and $(M_4^2)_{U.D.}$ is investigated for muon capture in ^{16}O. Earlier investigation has employed supermultiplet theory to obtain $(M_7^2)_{U.D.} = (M_5^2)_{U.D.} = (M_4^2)_{U.D.}$; therefore the correctness of a supermultiplet grouping of important muon capture nuclear final states as realistic supermultiplet symmetry breaking interactions is included in the nuclear Hamiltonian. Basis wavefunctions are taken to be simple shell model L–S coupled states belonging to the $(1p)^{-1}2s$ and $(1p)^{-1}1d$ configurations of ^{16}O. Energy eigenvalues and eigenfunctions of various nuclear Hamiltonians are obtained by evaluating the residual interaction matrices that mix the simple basis states. The results indicate that the spin-independent interparticle forces isolate the unretarded dipole muon capture strength in the supermultiplet lying highest in energy. The energy difference between this supermultiplet and lower lying supermultiplets precludes the large amount of supermultiplet mixing one might expect when tensor and spin-orbit forces are added to the Hamiltonian. Therefore it is found that the muon capture strength remains concentrated in the giant dipole region, and the muon capture supermultiplet remains substantially pure. In all cases, $(M_7^2)_{U.D.} = (M_5^2)_{U.D.} = (M_4^2)_{U.D.}$ remains a valid assumption to within 12%. (Disser. Abstr.)

35431 SPINS OF THE 5.03 MeV AND 2.14 MeV STATES IN ^{11}B FROM ANGULAR CORRELATION MEASUREMENTS IN $^{10}B(d,p)^{11}B$. Whalen, Brian Austin. Vancouver, B. C., Univ. of British Columbia, 1966.

Thesis.

An experimental investigation of the spins of the 2.14 (J_1) and 5.03 (J) MeV levels in ^{11}B was made using the $^{10}B(d,p)^{11}B$ reaction to populate the 5.03 MeV level in ^{11}B and then studying pγ and p$\gamma\gamma$ angular correlations to determine the values of J and J_1. The theoretical analysis of the angular correlation data is based on a method in which the (d,p) reaction mechanism is represented by a relatively small number of experimentally determined parameters and therefore the resulting spin assignments are not open to the usual criticisms of the use of (sometimes doubtful) nuclear reaction theories for the positive determination of nuclear spins. Using the information gained from this experiment and previous experimental information on the statistical distribution of M1 to E2 multipole mixing ratios it was possible to assign an overwhelming statistical probability in favor of the $J = 3/2$, $J_1 = 1/2$ spin assignment. These spin assignments are in agreement with previous tentative ones and with the theoretical shell model calculations of Cohen and Kurath. The parameters, determined by the experiment, describing the (d,p) reaction are compared with those calculated using stripping theory and are shown to be in disagreement with both the Butler Plane Wave and Distorted-Wave Born approximation calculations. (Disser. Abstr.)

35432 THE (p,2p) REACTION IN HELIUM AND CARBON. Kramer, George Donald. Cincinnati, Univ. of Cincinnati, 1966. 54p.

Thesis.

The (p,2p) reaction in ^4He and ^{12}C was experimentally investigated by Stubbins whose results show a broader angular distribution between the two outgoing protons from ^{12}C than from ^4He. This analysis was undertaken in an attempt to explain the broadening. At first it was suggested that, since the ^{12}C nucleus is bigger than the helium nucleus, the measurements would be influenced by the nuclear size. Following the collision of the incident proton with a proton in the nucleus, the two outgoing protons travel through more nuclear matter, on the average, before leaving the ^{12}C nucleus than they do in passing out of the ^4He nucleus. The assumptions are that the interaction occurs with equal probability throughout the entire volume of the nucleus, and that the target protons have the same momentum distribution in both nuclei. The result of the analysis of the first suggestion using the optical model is negative in that the calculated angular distribution is the same for ^4He as it is for ^{12}C. The trouble centers around the fact that the optical model is not able to explain scattering phenomena in light nuclei. Further considerations show that for incident particles of high energy, the nucleus is essentially transparent in the sense that the incident particle interacts with the individual nucleons instead of the entire nucleus, and the probability of further interactions is small. In this case, the interaction is a direct reaction between the incident proton and a target nucleon (either a proton or neutron). The theory of direct interactions is used with the shell model of the nucleus, and a nonrelativistic analysis is undertaken to test this hypothesis. The analysis indicates a broadening in the angular distribution of carbon compared to helium in accord with the experiment. To compare with the experiment, the direct interaction calculation was made using relativistic kinematics, since the incident proton energy is 770 MeV. The angular distributions are found to be in close agreement with the experiment. There remains a slight difference in the position of the theoretical peak of the angular distribution for helium compared to the experiment which comes into agreement when an excitation energy is subtracted from the energy available to the two outgoing protons. This would imply that the residual nucleus is left in an excited state. However, since the position of the peak for the carbon data agrees with the experiment, then this agreement would be removed if the same excitation energy were subtracted in the carbon analysis. Further experimental evidence is required to resolve the slight difference between the calculated and experimental peak of the angular distribution for ^4He. This study, which required extensive computations on the largest and fastest computers (IBM 7094 and CDC 6600), explains the experimental results by demonstrating the role of the nuclear shell structure in determining the angular distribution of the emerging protons in (p,2p) reactions at relativistic energies. (Disser. Abstr.)

35433 ELASTIC SCATTERING OF 14.1 MeV NEUTRONS FROM NITROGEN, OXYGEN, AND ARGON. Beach, Paul L. Athens, Ohio, Ohio Univ., 1966. 80p.

Thesis.

The differential elastic scattering cross sections of 14.1-MeV neutrons are measured for the target nuclei N, O, and Ar. The elastic scattering is separated from the inelastic contributions to the spectra for all three samples. From the differential cross sections the total elastic cross sections are found. Optical-model analysis gives the set of parameters for each sample which provides the best fit to the experimental data. The optical model potential consists of real central, imaginary derivative (surface), and real spin–orbit terms. The resulting parameters are compared with those for B, C, Ca, and K, which were obtained under similar experimental conditions and are analyzed using the same computer code. Corrections to the angular distributions to account for the finite geometry are of the order of 1%. Multiple scattering corrections are not included in the results. The sample diameter was less than 0.14 neutron mean free paths in all three samples. The differential cross sections were measured using the Ohio University neutron time-of-flight spectrometer. The neutrons were produced in the reaction $T(d,n)^4He$, using 150-keV deuterons from a Cockcroft-Walton accelerator. The associated-particle method was used with cylindrical geometry. Time resolution was about 1.5 nanosec. Flight paths from 1.24 to 1.80 m were used. The diameter of the scattering sample in each case was 3.14 cm, with the sample center located 13.5 cm from the neutron source. All three samples were in liquid form. The sample container was an insulated, thin plastic cylinder, constructed so that no boiling of the sample occurred in the scattering region. The absolute normalization of each differential cross section was found by comparing the measured response of the spectrometer for scattering from protons and carbon to the known cross sections for these nuclei. The differential elastic cross sections for 14.1 MeV neutrons for N, O, and Ar are given with over-all standard errors of 6 to 7%. For nitrogen and oxygen, the results are compared with previous measurements. The elastic scattering of 14.1-MeV neutrons from Ar has not been previously reported. Total elastic cross sections are found to be $\sigma_{el}(^{14}N) = 1.27 \pm 0.08$ b, $\sigma_{el}(^{16}O) = 1.05 \pm 0.08$ b, and $\sigma_{el}(^{40}Ar) = 1.00 \pm 0.07$ b. The differential cross section at zero degrees, determined from the extrapolation of forward angle scattering, is compared with the value of Wick's limit for each sample. The optical-model parameters, resulting from the fitting procedure, are presented and compared with the parameters for near-neighbor nuclei. The average values of the optical parameters for the nuclei in the mass region near A = 13 and those near A = 40 are given. (Disser. Abstr.)

Nuclear Properties and Reactions, $20 \leq A \leq 89$

Refer also to abstracts 34328, 34463, 35416, 35433, 35463, 35467, and 35489.

35434 (AD–649942) POLARIZED PROTON SCATTERING FROM OXYGEN AT 40.0, 37.1, 34.2, 30.4, 27.6, AND 24.2 MeV. Eldridge, Hudson Bluford (California Univ., Los Angeles. Dept. of Physics). Feb. 1967. Contract Nonr-233(44). 111p. (P–77). CFSTI.

Thesis.

A series of experiments designed to extend work on the optical-model description of nucleon-nucleus interactions by measuring the polarization, differential cross section, and reaction cross section for the proton–oxygen system at 24.2, 27.6, 30.4, 34.2, 37.1 and 40.4 MeV are summarized. These data are combined into an optical-model analysis in order to study both the validity of the model in this energy region as well as the behavior of the parameters in the energy regions about the resonances. (TSS) (TAB)

35435 (BMwF-FBK-67-25) SPEKTREN VON NEUTRON-ENEINFANGGAMMASTRAHLUNG AN GASEN IM TANGENTIALSTRAHLROHR EINES REAKTORS. (Spectra of Neutron Capture Gamma Radiation of Gases). Wille, P.; Bellmann, D. (Kiel Univ. (West Germany). Institut fuer Reine und Angewandte Kernphysik). Mar. 1967. 17p. (In German). Dep.

Spectrometry of gamma radiation following neutron capture of internal targets in a reactor was performed by NaI (Tl) scintillation detectors. A 5 in. × 4 in. NaI (Tl) detector in total absorption and a three-crystal pair spectrometer were used. The targets were nitrogen, neon, and argon. The measurements were performed to test if lithium-drifted germanium detectors could be used in this configuration concerning background and intensity of the spectra. The uncorrected spectra measured with the pair spectrometer are given. The measurement on nitrogen (5 in. × 4 in. NaI) was done to get the average neutron flux in the port. (auth)

35436 (BNL-11484) ELECTROMAGNETIC LIFETIMES. Warburton, E. K. (Brookhaven National Lab., Upton, N. Y.). [1967]. 40p. (CONF-670615-1). Dep. CFSTI.

From Symposium on Nuclear Physics Research With Low-Energy Accelerators, College Park, Md.

A review is given of techniques used to measure electromagnetic lifetimes of nuclear levels in light- and medium-weight nuclei which can be accomplished using small (energy ≤4 MeV) accelerators. The methods discussed are electronic timing (pulsed-beam techniques, delayed coincidences, etc.); recoil distance; Doppler-shift attenuation (including Doppler-shape measurements); and capture cross section methods. A number of experimental examples are given. (S.F.L.)

35437 (EANDC(E)–76(U)) NUCLEAR DATA RESEARCH IN THE EURATOM COMMUNITY. Progress Report, January 1–December 31, 1966. (European–American Nuclear Data Committee). Jan. 1967. 203p. Dep.

IRON-57—neutron total cross sections at 20 to 220 keV (E)
MANGANESE-55—neutron total cross sections and resonance parameters at 53 to 208 keV (E)
VANADIUM-51—neutron total cross sections and resonance parameters at 4 to 153 keV (E)
CADMIUM, CESIUM, HAFNIUM, INDIUM, MOLYBDENUM, NIOBIUM, PALLADIUM, RHENIUM, SILVER, TANTALUM, TUNGSTEN—neutron capture cross sections at 10 to 150 keV (E)
NUCLEI—neutron capture cross sections for Z = 41 to 75, at 10 to 150 keV (E)
NEUTRONS, FAST—capture cross sections for Z = 41 to 75 nuclei at 10 to 150 keV (E); reactions with manganese-55 at 53 to 208 keV, total cross sections and resonance parameters for (E); reactions with vanadium-51 at 4 to 153 keV, total cross sections and resonance parameters for (E)
GOLD-197—neutron capture cross section at 30 keV (E)
NEUTRONS, FAST—capture cross section for gold-197 at 30 keV (E)
PLUTONIUM-239, PLUTONIUM-240—neutron fission cross section at 5 to 150 keV (E)
NEUTRONS, FAST—reactions (n,f) with plutonium-239 and -240 at 5 to 150 keV, cross sections for (E)
URANIUM-235—neutron fission cross section at 30 and 64 keV (E)
NEUTRONS, FAST—reactions (n,f) with uranium-235 at 30 and 64 keV, cross sections for (E)
GRAPHITE—neutron scattering law at 533°K, cold (E)
NEUTRONS, COLD—scattering law for graphite at 533°K (E)
NEUTRON SPECTROMETERS—development of proton-recoil time-of-flight
ALUMINUM-27—neutron total cross section at 1.4 to 17 MeV (E)
CALCIUM—neutron total cross section at 0.9 to 4.8 MeV (E)
IRON—neutron total cross section at 0.5 to 3.1 MeV (E)
NEUTRONS, FAST—reactions (n,α) with carbon-12 and fluorine-19 at 14 MeV, cross sections for (E)
CARBON-12, FLUORINE-19—neutron reactions (n,α) at 14 MeV, cross sections for (E)
COMPUTERS—development of on-line
RADIATION DETECTORS, SEMICONDUCTOR—development of surface-barrier
DYSPROSIUM, ERBIUM, HOLMIUM, LUTETIUM, TERBIUM, THULIUM—neutron total cross section at 0.14 to 3 MeV (E)
NEUTRONS—reactions with dysprosium, erbium, holmium, lutetium, terbium, and thulium at 0.14 to 3 MeV, total cross sections for
ZINC-69, ZINC-70, GERMANIUM-70, GERMANIUM-79, GERMANIUM-76, SELENIUM-76, SELENIUM-78, SELENIUM-82, STRONTIUM-84, STRONTIUM-86—neutron capture cross sections for, thermal (E)
NUCLEI—neutron capture cross sections for A = 69 to 86, thermal (E)
NEUTRONS, THERMAL—capture cross sections for A = 69 to 86 nuclei (E)
MOLYBDENUM-98—neutron activation resonance integral for (E)
NEUTRONS—reactions with molybdenum-98, activation resonance integral for (E)
CHLORINE-35—neutron reactions (n,2n) at 15 to 16 MeV, cross sections for (E)
CHROMIUM-52—neutron reactions (n,2n) at 13 to 20 MeV, cross sections for (E)
GERMANIUM-76—neutron reactions (n,2n) at 13 to 17 MeV, cross sections for (E)
SELENIUM-80—neutron reactions (n,2n) at 13 to 17 MeV, cross sections for (E)

BROMINE-79—neutron reactions (n,2n) at 13 to 16 MeV, cross sections for (E)
BROMINE-79—neutron inelastic scattering cross sections at 13 to 16 MeV (E)
INDIUM-115, CERIUM-140, LEAD-204—neutron reactions (n,2n) at 13 to 17 MeV, cross sections for (E)
CERIUM-142—neutron reactions (n,2n) at 12 to 20 MeV, cross sections for (E)
ARSENIC-75—neutron reactions (n,p) at 13 to 17 MeV, cross sections for (E)
GOLD-197—neutron inelastic scattering cross sections at 13 to 16 MeV (E)
NEUTRONS, FAST—scattering by bromine-79 and gold-197 at 13 to 16 MeV, cross sections for (E)
CHLORINE-37—neutron reactions (n,α) at 13 to 16 MeV, cross sections for (E)
NEUTRONS, FAST—reactions (n,2n) with A = 35 to 204 nuclei, cross sections for (E); reactions (n,p) with arsenic-75 at 13 to 17 MeV, cross sections for (E); reactions (n,α) with chlorine-37 at 13 to 16 MeV, cross sections for (E)
NUCLEI—nucleon interactions in heavy, residual (T)
NUCLEONS—interactions N + N in heavy nuclei, residual (T)
SILICON-28—neutron differential elastic and inelastic scattering cross sections at 14 MeV (E)
NEUTRONS, FAST—scattering by silicon-28 at 14 MeV, differential cross sections for elastic and inelastic (E)
HAFNIUM-177—neutron resonance parameters and spin (E)
URANIUM-235—neutron resonance spins and widths (E)
TUNGSTEN-187—half-life (E)
COBALT-59, COPPER-63—neutron capture cross sections for isomer production, thermal (E)
NEUTRONS, THERMAL—capture cross sections for cobalt-59 and copper-63, for isomer production (E)
TUNGSTEN-186—neutron capture resonance integral and parameters (E)
LITHIUM-6—neutron differential elastic scattering cross sections at 1.0 to 2.3 MeV, angular distributions of (E)
NEUTRONS, FAST—scattering by lithium-6 and -7 at 1.0 to 2.3 MeV, differential cross sections for (E)
LITHIUM-7—neutron differential elastic and inelastic scattering cross sections at 1.0 to 2.3 MeV, angular distributions of (E)
DEUTERONS—reactions (d,n) with carbon-12 and nitrogen-15, neutron angular distributions from (E)
CARBON-12, NITROGEN-15—deuteron reactions (d,n) with neutron angular distributions from (E)
URANIUM-235—neutron fission cross section at 4.7 to 300 eV (E)
NEUTRONS—reactions (n,f) with uranium-235 at 4.7 to 300 eV, cross sections for (E)
MOLYBDENUM—neutron capture cross section at 0 to 100 keV (E)
NEUTRONS—capture cross sections for molybdenum at 0 to 100 keV (E)
DATA RECORDING SYSTEMS—development for time-of-flight experiments
NEUTRONS, FAST—reactions (n,f) with uranium-235 at 7 to 14 MeV, neutron emission in (E)
URANIUM-235—neutron fission at 7 to 14 MeV, neutron emission in (E)
NEUTRONS, FAST—scattering by iron-56 at 0.6 to 1.0 MeV, angular distributions for elastic (E)
IRON-56—neutron elastic scattering at 0.6 to 1.0 MeV, angular distributions for (E)
LITHIUM-7—neutron differential elastic and inelastic scattering cross sections at 0.9 to 6.0 MeV (E)
NEUTRONS, FAST—scattering by lithium-7 at 0.9 to 6.0 MeV, differential cross sections for elastic and inelastic (E)
LITHIUM-6—neutron differential inelastic scattering cross sections at 4 to 12 MeV (E)
NEUTRONS, FAST—scattering by lithium-6 at 4 to 12 MeV, differential cross sections for inelastic (E)
COPPER-63—neutron reactions (n,p) at 16 to 18 MeV, excitation function for (E)
NEUTRONS, FAST—reactions (n,p) with copper-63 at 16 to 18 MeV, excitation function for (E)
BERYLLIUM-8—energy levels from beryllium-9 (He-3,α) and boron-10 (d,α) reactions (E)
PLATINUM-195—neutron capture by, gamma spectra and radiative widths for (E)
PLATINUM-196—energy-level spins and transitions from platinum-195 neutron capture (E)
PLATINUM-199—energy levels from platinum-198 neutron capture (E)
PLATINUM-198—neutron capture by, gamma spectra from resonance (E)
NEUTRONS—capture by platinum-195 and -198, gamma spectra from(E)
CADMIUM-114—conversion-electron spectra (E)
URANIUM-235—neutron fission of, fragment angular and energy distributions in thermal (E)
NEUTRONS, THERMAL—reactions (n,f) with uranium-235, fission-fragment angular and energy distributions in (E)
NEPTUNIUM-237—neutron fission and total cross sections (E)
GRAPHITE—neutron diffusion lengths in (E)
NEUTRONS—diffusion lengths in graphite (E) (D.C.W.)

35438 (ORNL-P-3052) NEUTRON CAPTURE CROSS SECTIONS AND THE s-PROCESS. Gibbons, J. H.; Macklin, R. L. (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 41p. (CONF-670524-1). Dep. CFSTI.

From Symposium on the Origin and Distribution of the Elements, Paris, France.

Correlations were found between element abundance and neutron capture cross sections at energies corresponding to interior stellar temperatures and demonstrated the validity of the s-process theory of heavy element nucleosynthesis, disclosing the form of the neutron flux to which the solar system materials have been exposed. Tests using separated isotopes have bypassed the sometimes large uncertainties in elemental abundance and have shown, in some cases, highly quantitative agreement s-process calculations. Alternative abundance correlations, such as with neutron binding energy, were tested and were found to show no significance. (S.F.L.)

35439 CONVERSION OF ^{79m}Br. Schmidt-Ott, W.-D.; Flammersfeld, A. (Univ., Goettingen, Ger.). Z. Phys., 204: 173-6 (1967). (In German).

Natural Br was irradiated with fast neutrons to produce ^{79m}Br. The half-life, $T_{\frac{1}{2}} = 4.87 \pm 0.15$ sec, and the energy, $E_\gamma = 208 \pm 1$ keV, were remeasured. For the first time, the conversion coefficients were determined to be $\alpha_K = 0.25 \pm 0.02$ and $\alpha_{total} = 0.28 \pm 0.05$, yielding the multipolarity E3 for the isomeric transition. (auth)

35440 THE (e,e'p) REACTION IN THE ^{75}As NUCLEUS. Amaldi, Ugo Jr.; Campos Venuti, Gloria; Cortellessa, Giorgio; De Sanctis, Enzo; Frullani, Salvatore; Lombard, Roselyne; Salvadori, Paolo (Istituto Superiore di Sanita, Rome). Atti Accad. Naz. Lincei, Rend., Cl. Sci. Fis., Mat. Natur., 41: 494-6 (Dec. 1966).

Cross sections were obtained for the reaction ^{75}As(e,e'p) at energies of 590 to 600 MeV. Two main contributions to the spectrum, centered about energies of 620 and 710 MeV, are apparent. The sum of three Maxwellian curves plus a "background" straight line were fitted to the experimental points. The confidence level of the best fit is 25%. The curves are given, and the corresponding parameters are collected in a table together with the statistical errors. (S.F.L.)

35441 THE DECAY OF ^{127}Cs. Spalek, A.; Rezanka, I.; Frana, J.; Mastalka, A. (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Rez). Z. Phys., 204: 129-41(1967).

The decay of ^{127}Cs ($T_{\frac{1}{2}} = 6.2$h) was investigated by means of a Ge(Li) spectrometer and a double-focusing β-ray spectrometer. The decay scheme for ^{127}Cs is presented including eight new levels. The spins and parities of ^{127}Xe levels were determined. Based on the determination of the spins for the ground and first excited levels, the spin $^5/_2$ for the isomeric state of ^{127}Xe was proposed. The relative cumulative yields of cesium isotopes from the spallation of natural cerium with 660 MeV protons are given. (auth)

35442 ENRICHMENT OF ^{87m}Sr BY RECOIL EFFECT OF (n,2n) REACTION. Shiokawa, Takanobu; Yagi, Masuo; Hara, Mitsuo (Tohoku Univ., Sendai). J. Nucl. Sci. Technol. (Tokyo), 4: 297-9(June 1967).

A method was developed to enrich ^{87m}Sr by the (n,2n) reaction, as a preliminary study for the enrichment of ^{47}Ca. The method is based on capturing the recoils from a scattered target into a solidified phase of several percent by weight of gelatine in water. A fine strontium carbonate powder is suspended uniformly in gelatine phase and is irradiated with neutrons of 14 MeV. The results show that 4 ~ 23% of the induced ^{87m}Sr activities were separated into the gelatine phase, with an enrichment factor of 4 ~ 16. (auth)

35443 STATES IN ^{21}Ne NEAR 3 MeV. Bray, K. H.; Nurzynski, J. (Australian National Univ., Canberra). Nature (London), 215: 501-2(July 20, 1967).

A study of the reaction ^{22}Ne(^{3}He,α)^{21}Ne was undertaken to test the validity of the Nilsson model description of ^{21}Ne. Calculations

for both l = 0 and l = 2 angular momentum transfers are depicted graphically. There is clear indication of an l = 2 transition; the contribution from an l = 0 transition is apparently negligible. This l = 2 transition indicates either a $J^\pi = 3/2^+$ or $5/2^+$ state, and the results are consistent with the latest $3/2$ assignment to the 2.791-MeV state, and also indicate a positive-parity state. (UK)

35444 GAMMA RAYS FROM keV RESONANCE NEUTRON CAPTURE IN SOME (2s-1d)-SHELL NUCLEI. Bergqvist, I.; Biggerstaff, J. A.; Gibbons, J. H.; Good, W. M. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 158: 1049-62(June 20, 1967). (ORNL-P-2727).

The γ-ray spectra from radiative neutron capture in resolved resonances in F, Na, Mg, Al, S and from some unresolved resonances in Cl were measured with a NaI total-absorption spectrometer. Both positive- and negative-parity capturing resonances were studied, and from the simple spectra that were observed it was possible to obtain a number of branching ratios. On the basis of known final-state parities, E1 and M1 transition strengths were obtained. These were in good agreement with those of other nuclides in this region of atomic weight, thus establishing that with no outstanding exceptions, M1 competes favorably with E1 for these nuclides. An empirical rule, valid at least for neutrons of keV energy and lower, seems to operate in the case of the s-d-shell nuclides: The ratio of radiation strengths M1/E1 is greater for odd-Z, even-N target nuclides ($\approx 10^{-1}$) than it is for even-Z, even-N target nuclides ($\sim 10^{-2}$). (auth)

35445 LIFETIMES OF THE FIRST AND THE THIRD EXCITED STATES OF ^{41}Ca. Singh, P. P. (Argonne National Lab., Ill. Indiana Univ., Bloomington); Segel, R. E.; Siemssen, R. H.; Baker, S.; Blaugrund, A. E. Phys. Rev., 158: 1063-8(June 20, 1967).

The lifetimes of the $3/2^-$ first excited state of ^{41}Ca at $E_x = 1.95$ MeV and the $3/2^-$ third excited state at $E_x = 2.47$ MeV were measured by the attenuated-Doppler-shift method. The two states were populated through the ^{41}K(p,n)^{41}Ca reaction at bombarding energies only a little above threshold. The γ rays were detected with a lithium-drifted germanium detector. Measurements were made at 0 and 90° to the beam and with ^{41}Ca ions recoiling into vacuum, carbon, KCl, and gold. Some attenuation of the Doppler shift results from the recoiling ion changing its direction on collision with a nucleus. At the low recoil velocities encountered, this effect is comparable with the attenuation due to the energy loss in electronic collisions and it was explicitly taken into account. The lifetime of the first excited state was found to be 4.7×10^{-13} sec; that of the third excited state is $\geq 7 \times 10^{-13}$ sec. The speed of the E2 transition to ground from the first excited state is thus about three times the Moszkowski single-particle estimate. In contrast, the speed of the E2 ground-state transition from the third excited state (which decays mainly to the first excited state) is less than 6×10^{-3} of the single-particle estimate. These results are compared with theoretical predictions. (auth)

35446 DECAY OF ^{61}Cu AND ENERGY LEVELS IN ^{61}Ni. Bolotin, H. H.; Fischbeck, H. J. (Argonne National Lab., Ill.). Phys. Rev., 158: 1069-72(June 20, 1967).

The 3.3-hr positron decay of ^{61}Cu was investigated by use of Ge(Li) detectors and coincidence techniques. A total of 19 γ-ray transitions were observed ranging in energy from 67 to 2120 keV, of which only eight had been reported previously. The decay scheme based on these data incorporates all of these transitions and requires only those ^{61}Ni levels that have been excited in nuclear reactions. The excitation energies of the levels observed to be populated in ^{61}Ni from the decay of ^{61}Cu are 67.3, 282.8, 655.7, 908.8, 1100.2, 1132.4, 1185.5, 1446.9, 1611.8, 1730.2, and 2119.8 keV. (auth)

35447 STUDY OF THE ^{52}Cr(d,p)^{53}Cr REACTION IN THE COULOMB STRIPPING ENERGY REGION. Posner, Martin (Yale Univ., New Haven). Phys. Rev., 158: 1018-26(June 20, 1967).

The ^{52}Cr(d,p)^{53}Cr stripping reaction was studied at incident deuteron energies below the Coulomb barrier. The differential cross sections of proton groups corresponding to the ground and excited states of ^{53}Cr up to approximately 4.7-MeV excitation were measured at $E_d = 3.01$ MeV between 7.5 and 172.5°, and excitation functions for selected proton groups were measured between $E_d = 2.5$ and 3.25 MeV. As the proton energy goes below the Coulomb barrier, the proton angular distributions shift from forward to backward peaked distributions characteristic of Coulomb stripping. Distorted-wave Born-approximation analysis of the data indicates that in the Coulomb stripping region the absolute cross sections and angular distributions are very insensitive to the exact form of the optical-model potential parameters used to calculate the deuteron- and proton-scattering wave functions, as well as to the use of radial cutoffs in the numerical integration procedures. Reduced width factors were calculated. (auth)

35448 ANGULAR DISTRIBUTIONS OF PRODUCTS FROM REACTIONS OF COPPER ISOTOPES WITH ^{4}He IONS. Porile, N. T.; Saha, G. B. (Purdue Univ., Lafayette, Ind.). Contract AT(11-1)-1505. Phys. Rev., 158: 1027-41(June 20, 1967). (COO-1505-13).

Angular distributions of the recoil products of the ^{63}Cu(α,n) reaction as well as of the (α,2n), (α,3n), (α,2p), and (α,αn) reactions of ^{63}Cu were measured over the energy range of 20 to 43 MeV. The results were compared with a Monte Carlo evaporation calculation, and good agreement was obtained for a reasonable choice of the level-density parameter for all but the (α,n) and (α,αn) reactions at the higher energies. The discrepancies observed for the latter are indicative of a direct-interaction mechanism. Average properties of the angular distributions were used to obtain the average values of particle and photon energies for the various reactions. The information obtainable from transformations of the angular distributions between the laboratory and center-of-mass systems was explored. It was found that, on the assumption that the distribution of evaporation recoil velocities is isotropic and Gaussian, the laboratory distributions could be characterized by two parameters, namely the most probable evaporation velocity and a Gaussian width parameter. The latter could in turn be used to obtain average nucleon and photon energies. (auth)

35449 LIFETIMES OF THE FIRST TWO LEVELS IN ^{30}P. Kennedy, E. F.; Youngblood, D. H.; Blaugrund, A. E. (Argonne National Lab., Ill.). Phys. Rev., 158: 897-900(June 20, 1967).

The lifetimes of the first two levels in ^{30}P were measured by the attenuated-Doppler-shift technique. The measurements were analyzed by use of the universal stopping cross section given by Lindhard, Scharff, and Schiott, and a mean life $\tau = 1.55 \pm 0.30 \times 10^{-12}$ sec was obtained for the first level; for the second level only a lower limit ($\tau \geq 3.0 \times 10^{-12}$ sec) was obtained. The experimental result for the first level is compared with the value calculated from the corresponding Gamow–Teller β transition according to the relation given by Kurath. Slightly revised energies of 677.0 ± 1.0 and 709.0 ± 1.0 keV are assigned to these levels. (auth)

35450 ^{28}Si(^{4}He,^{16}O)^{16}O REACTION. Vandenbosch, R.; Norman, J. C.; Bishop, C. J. (Univ. of Washington, Seattle). Contract AT(45-1)-1388. Phys. Rev., 158: 887-92(June 20, 1967). (RLO-1388-16).

Cross sections and angular distributions were measured for the reaction ^{28}Si(^{4}He,^{16}O)^{16}O leading to the ground state and to several of the excited states of one of the product nuclei. The reaction where both product nuclei are left in excited states was also observed. The differential cross sections are quite small, of the order of 1 μb/sr. The reaction products were identified by simultaneous detection and two-dimensional analysis of both reaction products. The results are discussed in terms of the statistical theory of compound nuclear reactions. The observed angular distribution is consistent with the expectation that only the compound states with the highest available angular momentum ($J \sim 14$) contribute to the exit channel where both ^{16}O product nuclei are in their ground state. A statistical-model analysis of the absolute cross sections yields a value for the level density parameter a of (0.15 ± 0.02)A for mass numbers A in the region of 28-31. Deviations in the relative yields from that predicted by statistical theory are discussed in terms of possible shell-structure effects on nuclear deformabilities. (auth)

35451 FLUCTUATIONS IN NEUTRON TOTAL CROSS SECTIONS. Carlson, A. D.; Barschall, H. H. (Univ. of Wisconsin, Madison). Contract AT(11-1)-Gen-7. Phys. Rev., 158: 1142-56(June 20, 1967). (COO-7-0408).

The total cross sections of 18 elements from Mg to Bi were measured with energy spreads of 20 or 50 keV and a statistical accuracy of 1% as a function of neutron energy in the energy range from 4.5 to 7.5 MeV. No deviations from a smooth energy dependence were observed in the cross sections of the 10 elements from Co to Ta. For the remaining elements fluctuations were observed, the amplitudes of which decreased with neutron energy. For these elements, measurements were extended to higher energies until no fluctuations were observable. In addition, for Pb and Bi the energy interval from 2.5 to 4.5 MeV was investigated. The fluctuations could be accounted for by fluctuations in widths and spacings of compound-nucleus levels. It was not necessary to assume intermediate structure. Although the conditions for the Ericson theory of fluctuations may not be satisfied for all the measurements, this theory also accounts for the observed fluctuations at the higher energies. (auth)

35452 TRAPPING, DIFFUSION, AND DENSITY DISTRIBUTION OF DEUTERONS IN SELF-TARGETS OF GOLD, NICKEL,

AND COPPER. Heintze, V.; Kamke, D. (Univ., Marburg, Ger.). Z. Naturforsch., 22a: 796-808(May 1967). (In German).

The trapping and distribution of deuterons in self-targets consisting of gold, nickel, and copper has been investigated. The analysis of the proton-spectra of the d-d-reaction shows that in gold (5 ... 50 mg/cm^2) an inner and a surface part of the D(d,p) T-reaction exists, whereas in a massive gold target all reactions take place within the target; in gold foils having a thickness below 5 mg/cm^2 only surface reactions are observed. Likewise, massive nickel and copper targets show only a surface part of the d-d-reaction. An interpretation of these diverse spectra is given. Finally, a simple model of deuterium diffusion in a self-target is developed. (auth)

35453 NUCLEAR SPECTROSCOPY IN THE $1f_{\frac{7}{2}}$ REGION BY THE (p,d) AND (p,t) REACTIONS. Whitten, Charles Alexander, Jr. Princeton, N. J., Princeton Univ., 1966. 202p.

Thesis.

The ^{40}A(p,d) and (p,t), ^{51}V(p,d), ^{52}Cr(p,d) and (p,t), ^{53}Cr(p,d) and (p,t), ^{54}Cr(p,d) and (p,t), and ^{53}Cr(p,p') reactions were studied with 17.5 MeV protons from the Princeton FM cyclotron. Thin (~0.5 mg/cm^2) isotopic foils were used as targets in the vanadium and chromium reaction studies while a gas cell was used in the argon experiment. The deuterons and tritons were identified by a dE/dx - E solid state detector telescope. Total resolution of the system was ~55 to 70 keV. Absolute cross sections for the vanadium and chromium reactions were obtained using thick natural target foils. Angular distributions for many (p,d) and (p,t) transitions were obtained from $\theta_{LAB} = 15°$ to $\theta_{LAB} = 150°$. Spectroscopic factors for ln = 0, ln = 1, ln = 2, and ln = 3 (p,d) transitions were obtained by comparing the experimental angular distributions with the predictions of the distorted wave Born approximation (DWBA) theory of the (p,d) reaction. The DWBA program used approximated both finite range and non-local effects in the reaction mechanism. The ln = 3 ($j_n = \frac{7}{2}$) spectroscopic factors in the ^{51}V(p,d)^{50}V and ^{52}Cr(p,d)^{51}Cr reactions were compared with the predictions of the McCullen, Bayman, and Zamick theory, which assumes pure $(f\frac{7}{2})$ configurations for the levels in ^{50}V and ^{51}Cr. In the ^{53}Cr(p,d) reaction both the ^{52}Cr ground state and the 1.434 MeV 2$^+$ level were excited by $l_n = 1$ transitions, showing admixture in the ^{53}Cr ground state of the configuration $\{[^{52}\text{Cr}(1.434\ \text{MeV})]^{2+}2p_{\frac{3}{2}}\}^{\frac{5}{2}}$. Four levels in ^{52}Cr with excitation energies between 3.4 and 4.1 MeV were strongly excited in the (p,d) reaction by ln = 3 transitions, thus presenting strong evidence that their wave functions have large admixtures of the neutron configuration $(f^{-1}_{\frac{7}{2}}p_{\frac{3}{2}})^{J=2,3,4,5}$. In the ^{54}Cr(p,d)^{53}Cr reaction definite J dependence was seen in both the ln = 1 (J = ½ or ⅜) and ln = 3 (J = ⅝ or ½) (p,d) angular distributions. Strong ln = 3 ^{54}Cr(p,d) transitions were found to ½- levels in ^{53}Cr at 1.284, 1.532, and 3.339 MeV. In both the ^{54}Cr(p,d) and ^{52}Cr(p,d) reactions a single ln = 0 transition is found which seems to exhaust most of the $T_<$ spectroscopic strength. The ^{52,53,54}Cr(p,t) experiments along with the ^{53}Cr(p,d) work would indicate that the 2.648 MeV 0$^+$ level in ^{52}Cr is based upon the neutron configuration $\{(f^{-2}_{\frac{7}{2}})^0(2p^2_{\frac{3}{2}})^0\}^0$. The ^{40}A(p,t) experiment unambiguously assigns the 3.383 MeV level in ^{38}A a spin 0$^+$ on the basis of its L = 0 angular distribution. The results of the ^{54}Cr(p,d) and ^{53}Cr(p,p') experiments are used in conjunction with the weak coupling model and the models of Maxwell and Parkinson, and Ramavataram to discuss the structure of the low lying levels of ^{53}Cr. An attempt was made to compare the results of the work with the results of other reaction studies whenever possible. (Disser. Abstr.)

35454 ENERGY LEVELS OF ^{82}Kr POPULATED BY ^{82}Br DECAY. Raman, Subramanian. University Park, Pa., Pennsylvania State Univ., 1966. 124p.

Thesis.

The gamma rays following the beta decay of ^{82}Br were investigated using a 220 mm^3 Li-Ge detector, an anti-Compton NaI spectrometer and a two-dimensional coincidence arrangement. ^{82}Br was produced by thermal neutron activation of ammonium bromide. The energies (in keV) and relative intensities (in brackets) of eight well known gamma rays were identified as 554.0 ± 0.6 (81 ± 3), 617.9 ± 0.8 (55 ± 5), 697.7 ± 1.0 (29 ± 2), 775.6 ± 0.8 (100), 826.2 ± 0.7 (27 ± 2), 1043.3 ± 0.8 (38 ± 2), 1317.8 ± 0.7 (38 ± 3), and 1473.1 ± 0.9 (24 ± 2). In addition, eleven weak transitions have also been identified as 94 ± 2 (0.43 ± 0.1), 138 ± 4 (0.11 ± 0.05), 222 ± 2 (28 ± 0.8), 274 ± 3 (0.71 ± 0.3), 951 ± 2 (0.5 ± 0.1), 1008 ± 2 (1.6 ± 0.4), 1649.5 ± 2.5 (1.0 ± 0.4), 1778 ± 3 (0.2 ± 0.05), 1868 ± 2 (0.05 ± 0.01), 1953 ± 2 (0.07 ± 0.01) and 2057 ± 5 (0.03 ± 0.01). It was established through indirect half-life measurements that these gamma rays belong to ^{82}Br decay and that the high energy peaks are not due to summing effects. All the reported gamma rays have been incorporated in a level scheme of ^{82}Kr by introducing levels at 0, 776, 1474, 1820, 1953, 2093, 2426, 2554, 2647, and 2828 keV. A reasonable intensity balance was obtained and limits on probable spin and parity values for the newly introduced levels were established. The level introduced at 2828 keV on the basis of a 1008-1044 keV gamma-gamma coincidence must be fed by a weak (~1.3%) beta branch of ^{82}Br with an end-point energy of 263 keV and log ft value of ~6.1. The collective nature of some of the above levels is also considered. (Disser. Abstr.)

35455 A SPARK-CHAMBER SEARCH FOR DOUBLE BETA-DECAY IN ^{48}Ca. THE DECAY SCHEME OF ^{56}Fe FROM COINCIDENCE AND HIGH RESOLUTION MEASUREMENTS OF THE ^{56}Fe(p,p'γ) REACTION. Shapiro, Mark Howard. Philadelphia, Univ. of Pennsylvania, 1966. 246p.

Thesis.

A search for the double beta-decay of ^{48}Ca using a detection system which combines two four-gap aluminum foil spark-chambers of 32 mg/cm^2 thickness with plastic scintillation counters operated in time coincidence is described. This combined electronic and visual detection system has the advantages of increasing the specificity of the "signature" that can be demanded for double beta-like events, and reducing the effective background from γ-rays at the low energy end of the two-electron sum spectrum. This increases the sensitivity for the two-neutrino mode of the decay considerably. After scanning ~420,000 photographs of events from a source-dummy matrix consisting of 3 g of ^{48}Ca and 1 g of ^{40}Ca that were taken during a 1838.4 hr run, no statistically significant differences in the rate of double beta-like events from the source and dummy were noted, either in the energy region where two-neutrino double beta-decay might be expected or in the energy region where neutrinoless double beta-decay might be expected. A lower limit on the half-life for the two neutrino mode of the decay was set at 3.2×10^{18} yr, and a lower limit of 9×10^{18} yr was placed on the neutrinoless mode. The decay scheme of ^{56}Fe was determined from coincidence measurements of the γ-rays and inelastically scattered protons from the ^{56}Fe(p,p'γ) reaction at E_p = 6.0 and 7.0 MeV. High resolution spectrograph and Ge(Li) counter measurements established the existence of doublets at 3.118 MeV, 3.443 MeV, and 3.599 MeV with spacings of 3, 3, and 6 keV respectively. The results of these measurements were combined with recent γ-ray angular distribution measurements and recent nuclear reaction data to determine spins and parities for levels up to 3.853 MeV. The experimental spectrum was found to be in good agreement with shell model predictions. (Disser. Abstr.)

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Refer also to abstracts 34463, 35416, 35437, 35451, 35499, 35503, and 35525.

35456 (AD-651111) NEUTRON SPECTRA FROM MONOENERGETIC PHOTONS ON BISMUTH. Hanson, A. O.; Sutton, D. C. (Illinois Univ., Urbana. Dept. of Physics). 1967. Contract Nonr-1834(05). 50p. CFSTI.

Thesis.

Spectra of photoneutrons from a ^{209}Bi target were obtained in the electric dipole giant resonance region (12 to 16 MeV). Gamma-ray energy resolution of 1.5% was attained using a bremsstrahlung monochromator; the neutron energies were measured with a time-of-flight technique with resolution which varied from 10% at 2 MeV to 15% at 6 MeV. About 88% of the neutrons emitted by 14-MeV gamma rays are statistical. The inferred level density of ^{209}Bi near its ground state is not a simple function of excitation energy, but from 4 to 7 MeV it increases exponentially with energy. In that energy range the temperature is about 1 MeV. The nonstatistical high-energy neutrons leave the ^{208}Bi nucleus at the excitation energies at which the states are well represented as single-neutron holes in ^{209}Bi. These high-energy neutrons are intimately connected with the giant resonance. If the giant resonance is dominated by a single dipole state, the absolute width which characterizes the decay of the dipole state into the compound nucleus must increase by a factor of about 3 between 12 and 16 MeV. (auth) (TAB)

35457 (AEET-272) SELF-SHIELDED CROSS SECTIONS FOR THE MAIN FERTILE AND FISSILE NUCLEI. Singh, R. Shankar; Desai, G. A. (Atomic Energy Establishment, Trombay (India)). 1966. 18p. Dep.

Self-shielded cross-sections for ^{232}Th, ^{235}U, ^{238}U, and ^{239}Pu which exhibit resonance behavior in their reaction cross-sections with neutrons are necessary to represent the proper effective values in a multigroup analysis of reactors and to predict accurately the reactivity coefficients due to the Doppler effect, etc. These were evaluated from resonance-integral calculations under the narrow-resonance approximation using the latest available resonance parameters at four temperatures (300, 750, 1500, and 2500°K) and at σ_p (potential scattering cross section per absorber atom) values of

40 and 60 barns for ^{232}Th and ^{238}U and 126, 200, 300, and 400 barns for ^{235}U and ^{239}Pu. The status of resonance parameters for these elements is also discussed in detail. (auth)

35458 (CEA-R-3077) ETUDE DES RESONANCES DE NEUTRONS EN FONCTON DE LEUR SPIN POUR LES NOYAUX 1 = ½ (ARGENT, THULIUM ET PLATINE) ENTRE 1 ET 800 eV. (Study of Neutrons Resonances for Nuclei of Spin ½ (Silver, Thulium, Platinum) Between 1 and 800 eV). de Barros, Solange May (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1967. 67p. (In French). Dep.

Thesis. Submitted to Paris Univ., Orsay, France.

The parameters of 239 resonances in Pt, ^{195}Pt, ^{107}Ag, ^{109}Ag, and ^{169}Tm were determined on the basis of capture and transmission experiments. Spin assignments were made for 120 of these resonance levels. It was found that the ratio of the average spacing of each spin state obeys the law 2J + 1. The density function appears to be independent of the spin 0 or 1 of the compound nuclei for target nuclei with I = ½. (D.C.W.)

35459 (COO-1112-110) THE ^{208}Pb(d,p)^{209}Pb REACTION WITH 15 TO 25 MeV DEUTERONS. Poltorak, Andrew Stephen (Michigan Univ., Ann Arbor). 1966. Contract AT(11-1)-1112. 78p. Dep. CFSTI.

Thesis.

An attempt was made to measure the absolute differential cross sections for the seven lowest neutron energy levels in ^{209}Pb with deuteron energies of 15, 20, and 25 MeV and to compare the results with the predictions of a DWA analysis for these levels. Since the levels should correspond to pure single-particle states with known l-values, the spectroscopic factors should be unity. As a result a calibration and evaluation of the validity of the DWA theory in the high Z nuclei, at these deuteron energies, are possible. The measurements and analysis made verified the location and identification of the seven expected single-particle levels in ^{209}Pb. The Q-values of the levels were determined to within ±10 keV, and the separation of the two levels near 2.5 MeV excitation energy was determined to within ±3 keV. These results are in reasonable agreement with earlier measurements. The l-values of the states were determined by comparison of the DWA predictions with the measured differential cross sections. The assignment of the total angular momentum to the levels was made on the basis of shell-model considerations, namely that j = l + ½ states are more strongly bound to the nucleus. There was no evidence of a j-dependence in either the measured or DWA differential cross sections. To obtain spectroscopic factors closest to the expected values of unity from the DWA analysis, only the approximations of the range of the interaction and the locality of the potentials representing the nuclei, and the lower integration limit were changed in the analysis; and no parameter variations were made. The DWA analysis was done with a zero-range interaction, local potential approximation; finite-range interaction and nonlocal distorted-wave potentials, in the local energy approximation; and finite-range interaction nonlocal distorted-wave and bound-state neutron potentials, also in the local energy approximation. Each of these was calculated with the same set of parameters for all levels at all energies with the lower cutoff of integration of the transition amplitude being set at 0, 6, and 8 fermis. The best agreement with the data was found with a finite-range interaction and nonlocal distorted-wave potentials with no lower integration cutoff. Using the best conditions as standard, the other two conditions gave results with lower spectroscopic factors, but with essentially the same shape of the angular distributions. The effect of introducing the lower cutoff of integration was random in both the shape and magnitude of the predicted cross sections. The only parameter variation used in the DWA analysis was a new set of proton parameters, from 30 MeV data, in the 25 MeV, zero-range, local potential calculations. A general improvement of the spectroscopic factors for zero-range, local potential calculations was obtained, with only minor changes in the shapes of the angular distributions. The measured and theoretical peak cross sections and the theoretical integrated cross sections as a function of deuteron energy are observed to be dependent on the l-value of the level. All show a definite trend that high angular momentum becomes easier to transfer at higher deuteron energies; conversely, low angular momentum becomes more difficult to transfer. In conclusion, in view of the objective of the work described, namely the calibration of the DWA analysis for direct reactions on heavy nuclei, only partial success was obtained. While l-values can be determined reliably from the measured differential cross sections in (d,p) reactions, there is no apparent j-dependence, either measured or predicted. The extraction of spectroscopic factors is reliable only to about ±40%. It is evident, therefore, that the distorted-wave analysis in its present form is not the ideal tool for obtaining spectroscopic factors for energy levels by means of (d,p) reactions on heavy elements. Nevertheless, it still is valuable and will provide useful spectroscopic information for other heavy nuclei. (auth)

35460 (KFK-541) MESSUNGEN AM ZERFALL DES ^{200}Bi UND ^{202}Bi. (Measurement of the Decay of ^{200}Bi and ^{202}Bi). Hanser, A.; Freitag, K. (Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron-Laboratorium). Feb. 1967. 22p. (In German). Dep.

From the decay of ^{200}Bi and ^{202}Bi, γ-spectra, conversion-electron spectra, γ-γ coincidences, γ-e coincidences, and conversion coefficients were measured using mass-separated samples. Four excited levels of ^{200}Pb were found. Probable spin-parity assignments are given. The level scheme of ^{202}Pb known from investigations on ^{202m}Pb was confirmed. Lower limits for the very high decay energies of both nuclei are given, and the relatively small overall positon emission rates were measured. (auth)

35461 (LS-174) DELAYED NEUTRONS. PART II. AN ANNOTATED BIBLIOGRAPHY. Gilbert, B. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Mar. 1967. 52p. Dep.

References to literature on the emission of delayed neutrons and the effects of delayed neutrons in reactors are presented. Author and subject indexes are included. 128 references. (D.C.W.)

35462 (NP-16859) RATIOS OF E2 TRANSITION PROBABILITIES OF DEFORMED EVEN-EVEN NUCLEI. Abecasis, S. M.; Bosch, H. E. (Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina)). Mar. 1967. 33p.

Several ratios of E2 transition probabilities between levels belonging to the ground-state and beta- and gamma-rotational bands in deformed even-even nuclei are numerically calculated within the framework of the rotation-vibration interaction model. A detailed comparison of the theoretical predictions with available experimental data is performed. It is concluded that this model gives at the present one of the best agreements with experiment without the introduction of empirically determined parameters. (auth)

35463 (RT/FI-(67)4) VALUTAZIONE DEGLI INTEGRALI DI RISONANZA DEI NUCLEI PRODOTTI DA FISSIONE. (Evaluation of Resonance Integrals of Fission Product Nuclei). Palmucci, M. A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1967. 14p. (In Italian). Dep.

The resonance integrals of some fission-product nuclei are evaluated by means of the most recent single-level resonance parameters. Calculated values are compared, whenever possible, with experimental values. (auth)

35464 (TID-23888) MUONIC X RAYS OF BISMUTH. Bardin, Tsing Tchao (Columbia Univ., New York. Dept. of Physics). 1966. Contract AT(30-1)-Gen-72. 107p. Dep. CFSTI.

Thesis.

The muonic x rays from the spherical nucleus ^{209}Bi were detected by Li-drifted germanium solid-state detectors with an energy resolution of 0.1% at 6-MeV gamma energy. The hyperfine structure due to the magnetic dipole and the electric quadrupole interactions between the muon and the nuclear charge and magnetic moment distributions was observed. The interpretation of such interactions assuming different nuclear models is discussed and compared with the experimental observations. The parameters of the spherical charge distribution of the extended nucleus as described by the "Fermi distribution" were determined from the transition energies of the K and L muonic x rays. The mean radius c and the skin thickness t are found to be $c = 1.126 \mp 0.005$ $A^{\frac{1}{3}}$ F and $t = 4 \log_e 3 \times 0.5106$ F, respectively. The experimental results confirm and extend the anomalous intensity ratios previously observed in muonic x-ray transitions. The experimental results also provide information on the mode of cascade of the muon in the muonic Bohr orbits. The cascade is direct, i.e., 4f → 3d → 2p → 1s, within 15% accuracy in intensity. (auth)

35465 (TID-23889) MASS DISTRIBUTIONS OF FISSION FRAGMENTS IN THERMAL-NEUTRON INDUCED FISSION OF ^{235}U FROM CORRELATED ENERGY AND TIME-OF-FLIGHT MEASUREMENTS. Derengowski, Mary A. (Columbia Univ., New York. Dept. of Physics). 1967. Contract AT(30-1)-Gen-72. 135p. Dep. CFSTI.

Thesis.

An experiment was performed on the thermal-neutron-induced fission of ^{235}U in which the energy of correlated fission fragments and the time-of-flight of one fragment are recorded simultaneously. The post-neutron fragment masses are calculated directly from the time-of-flight and energy of one fragment. A new technique is used to obtain the pre-neutron masses indirectly from the time-of-flight of one fragment and the average time-of-flight of the complementary fragment. The primary and post-neutron mass distributions are formed as a function of total kinetic energy of the fragments. The primary mass distributions for fixed ranges of total kinetic energy show structure suggesting that the distribu-

tions can be decomposed into partial distributions whose centers are 4 amu apart. A comparison between primary and post-neutron mass distributions indicates that the structure present in the primary mass division is preserved in the post-neutron distributions. No new structure is produced by the neutron emission, with the possible exception of the peak at mass 134, although the resolution of the present experiment is not good enough to resolve this peak. Neutron emission as a function of both mass and total kinetic energy is derived from the data by subtraction of the post-neutron mass from the pre-neutron mass. (auth)

35466 (UCRL-17460) HYPERFINE STRUCTURE AND MAGNETIC MOMENT OF ^{110m}Ag AND SPIN OF ^{163}Tm. Schmelling, Stephen G. (California Univ., Berkeley. Lawrence Radiation Lab.)) Mar. 29, 1967. Contract W-7405-eng-48. 84p. Dep. CFSTI.

Thesis.

The atomic-beam magnetic-resonance technique was used to measure the free-atom ground-state hyperfine-structure separation $\Delta\nu$, the nuclear magnetic moment μ_I, and the hyperfine-structure anomaly $^{109}\Delta^{110m}$ of 260-day ^{110m}Ag (I = 6). The magnetic moment μ_I was obtained independently of $\Delta\nu$ by observing a $\Delta F = \pm 1$ doublet at its field-independent point. The results are $\Delta\nu(^{110m}Ag) = +30313.756(4)$ MHz, $\mu_I(^{110m}Ag)$ (uncorr) = +3.587(4) nm, and $^{109}\Delta^{110m} = -2.47(12)\%$. A short experiment was also done to measure the nuclear spin of 108-min ^{163}Tm. The result of this experiment is I = ½ for ^{163}Tm. (auth)

35467 PHOTOACTIVATION OF RARE-EARTH ELEMENTS WITH 20-MeV BREMSSTRAHLUNG. Oka, Yoshinaga (Tohoku Univ., Sendai); Kato, Toyoaki; Nagai, Iwao. J. Nucl. Sci. Technol. (Tokyo), 4: 300-7(June 1967).

The oxides of scandium, yttrium and all elements from lanthanum through lutetium, except promethium, were irradiated for 1 hr with bremsstrahlung γ rays converted from a 20-MeV electron beam; and the radioactive species produced as a result were examined on the basis of photonuclear reactions, their yields, and their applicability to activation analyses. The sensitivity and selectivity of the proposed method are discussed from the data thus obtained. The (γ,n) reaction was predominant for most elements, and at least 28 product nuclides have been identified. A number of other $(\gamma,2n)$ reactions were also observed. The yields of the (γ,n) reactions were estimated for the lanthanide rare earths through measurement of the resultant activity to be about 10^9/mole·R and somewhat more than 10% smaller for the corresponding $(\gamma,2n)$ reaction. Reactions with charged-particle emission contributed only a small fraction in the observed radioactivity. Extraneous activity arising from neutron capture was also measured; these activities could be reduced considerably by encasing the sample in boron. The lower limits of detection averaged about 1 μg for most of the rare-earth elements. (auth)

35468 NUCLEAR ALIGNMENT OF THE $^1S_0$ GROUND STATE OF ^{131}Xe BY ELECTRON PUMPING AND METASTABILITY-EXCHANGE COLLISIONS. Hadeishi, Tetsuo; Liu, Chung-Heng (Univ. of California, Berkeley). Phys. Rev. Lett., 19: 211-13 (July 31, 1967).

An alignment of a nucleus in the $^1S_0$ ground state of ^{131}Xe was achieved through exchange collisions with atoms in the metastable state formed and aligned by electron impact. It was observed by monitoring the change of linearly polarized resonance radiation by the Xe($^3P_2$) metastable state during a nuclear magnetic resonance. (auth)

35469 ELASTIC ELECTRON SCATTERING FROM ^{208}Pb AT 175 AND 250 MeV. Bellicard, J. B.; van Oostrum, K. J. (Stanford Univ., Calif.). Phys. Rev. Lett., 19: 242-4(July 31, 1967).

Absolute cross sections for the elastic scattering of 175- and 250-MeV electrons from lead-208 were measured, and a partial-wave analysis of the data was made for a Fermi-type nuclear charge distribution described with two or three parameters. A comparison with low-energy electron and muonic x-ray results is given. (auth)

35470 RADIOACTIVE DECAY OF ^{147}Nd. Rajput, M. S.; Sehgal, M. L. (Aligarh Muslim Univ., India). Indian J. Phys., 41: 176-82(Mar. 1967).

The decay of ^{147}Nd to the levels of ^{147}Pm was studied using scintillation and coincidence techniques. To confirm the existence of the second 91-keV gamma ray originating from the level at 182 keV, the detection efficiency of the NaI(Tl) crystal for the 91-keV gamma ray was measured in the 91–91 keV coincidences in the fixed geometry. By comparing the experimental value of the detection efficiency with the standard value, it was found that the percentage of the second 91-keV gamma ray is about 10 ± 2%. The K-conversion coefficient of the 91-keV gamma ray, which is in coincidence with the 599-keV gamma ray was measured to be 1.6 ± 0.2. The K-conversion coefficient of the 91-keV gamma ray originating from the 182-keV level is estimated to be 0.92 ± 0.53. (auth)

35471 EFFECT OF NUCLEAR STRUCTURE ON INTERNAL CONVERSION PROCESSES. Begzhanov, R. B.; Rakovitskii, S. L. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 40-5(1966). (In Russian).

The internal conversion coefficient (ICC) can be represented in the form of two components: one due to conversion outside the nucleus, and one due to conversion inside the nucleus as a result of electron penetration. The intranuclear component depends on details of nuclear structure. The penetration parameter λ is introduced in estimating structural effects on the internal conversion coefficient (ICC): $\lambda = M_e/M_\gamma$. Here M_e is the intranuclear matrix element of the penetration, and M_γ is the normal matrix element of the gamma emission. An expression is given for the dependence of ICC on λ in the case of a M1-transition. Data on the ICC and the e-γ-angular correlation show the penetration effect, which at present has been found in three types of transitions: delayed E1- and M1-transitions, and also E0-transitions. Data on the E0-impurity in a mixed $2_2^+ \rightarrow 2_1$-transition are few in number but indicate the presence of a E0-contribution in ^{152}Sm, for example, which is directly related to the penetration effect. The effect of nuclear structure on the conversion processes of allowed and l-forbidden M1-transitions in ^{201}Tl and ^{203}Tl could not be found in the allowed transition ($\lambda \approx 1$), but was found in the l-forbidden M1-transitions ($\lambda = 5$ and 7.5 respectively). Nuclear structure effects have been detected for the E1-transitions of ^{177}Hf and ^{176}Lu, and for E2-transitions of ^{152}Sm, ^{154}Gd, and ^{170}Yb. (TTT)

35472 NUCLEAR SPECTROSCOPIC STUDIES OF ^{257}Fm. Asaro, F.; Perlman, I. (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Rev., 158: 1073-7(June 20, 1967). (UCRL-16738).

The nuclear radiations associated with the α decay of ^{257}Fm were investigated by a variety of spectroscopic techniques. Alpha groups were observed with energies and intensities of ~6.75, 0.4 ± 0.2%?; 6.696 ± 0.003, 3.2 ± 0.3%; 6.519 ± 0.002, 94 ± 1%; 6.441 ± 0.003, 2.0 ± 0.4%; and ~6.35 MeV, ~0.5%?. Gamma-ray transitions were seen in coincidence with α particles with energies of 2.42, 180, and 62 keV. The ground state of ^{257}Fm is given the Nilsson assignment $^9/_2 + ^9/_2[615\downarrow]$ as is the 242-keV state of ^{253}Cf. The ground state of ^{253}Cf is given the assignment $^7/_2 + ^7/_2[613\uparrow]$. For these bands in the daughter nucleus the rotational constants $\hbar^2/2\mathfrak{I}$ have the respective values of 7.1 ± 0.4 and 7.0 ± 0.1 keV, the largest values found yet in the very heavy elements. Some of the α- and γ-ray transitions are interpreted in terms of a Coriolis interaction between the two assigned Nilsson levels in the daughter nucleus. (auth)

35473 HYPERFINE-STRUCTURE SEPARATIONS, NUCLEAR MAGNETIC MOMENTS, AND HYPERFINE-STRUCTURE ANOMALIES OF ^{198}Au AND ^{199}Au. Vanden Bout, Paul A.; Ehlers, Vernon J.; Nierenberg, William A.; Shugart, Howard A. (Univ. of California, Berkeley). Contract W-7405-eng-48. Phys. Rev., 158: 1078-84(June 20, 1967). (UCRL-17297).

The hyperfine-structure separations and nuclear magnetic moments of 2.70-day ^{198}Au and 3.15-day ^{199}Au in the $^2S_{\frac{1}{2}}$ state, were measured using the atomic-beam magnetic-resonance method. The ratios of the electronic g factor of gold to those of potassium and cesium were also measured. The results are, for ^{198}Au (I = 2), $\Delta\nu = 21450.7167(4)$ MHz, μ_I(uncorr) = +0.5842(4) nm; and for ^{199}Au (I = $^3/_2$), $\Delta\nu = 10962.7227(3)$ MHz, μ_I(uncorr) = +0.2673(7) nm. The results for the g-factor ratios are: $g_J(Au)/g_J(K) = 1.00054(2)$ and $g_J(Au)/g_J(Cs) = 1.000381(2)$. These values yield the following hyperfine-structure anomalies: $^{197}\Delta^{198} = 8.53(8)\%$ and $^{197}\Delta^{199} = 3.7(2)\%$. Second-order corrections to the hyperfine structure are shown to be negligible. The nuclear results are interpreted in terms of the shell model, with allowance made for configuration mixing. (auth)

35474 ^{92}Zr(^{3}He,^{3}He′) AND ^{92}Zr(^{3}He,α) WITH 51-MeV ^{3}He. Bingham, C. R.; Halbert, M. L. (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. Phys. Rev., 158: 1085-93(June 20, 1967). (ORNL-P-2867).

Differential cross sections for elastic and inelastic scattering and for (^{3}He,α) reactions were measured for 51.3-MeV ^{3}He on ^{92}Zr. The elastic scattering was analyzed with a six-parameter Woods–Saxon potential. Three distinct sets of parameters gave good fits. Inclusion of a spin-orbit term did not improve the best fit. The inelastic scattering was analyzed in terms of the collective model using the distorted-wave method. A complex interaction was needed to obtain good fits to the data; the imaginary component was dominant. Values of the deformation length $\beta_1 R_0'$ were in good agreement with those obtained from other experiments. The (^{3}He,α) cross sections were compared with zero-range distorted-wave predictions using a simple stripping interpretation. Good fits to the angular distributions were obtained

by selection among potentials which fit the elastic scattering in the entrance and exit channels. A normalization factor of 14.1 provides good agreement with (p,d) spectroscopic factors for angular momentum transfers of l = 2 and l = 4. The results are consistent with sum rules, indicating that the (^{3}He,α) reaction is well described by the distorted-wave theory and the simple stripping interpretation. (auth)

35475 DECAY-SCHEME STUDIES OF ^{125}Xe AND ^{127}Xe. Geiger, J. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 158: 1094-1104(June 20, 1967).

High-resolution conversion-electron studies were made of the ^{125}Xe and ^{127}Xe decay schemes. The energies in keV and multipolarities of the transitions seen in ^{125}I are 54.960 ± 0.015, M1 + (0.05 ± 0.03)%E2; 74.86 ± 0.02, E2 + <15%M1; 113.57 ± 0.03, M1 + (1.4 ± 0.4)%E2; 188.43 ± 0.03, M1 + (11.3 ± 0.5)%E2; 210.43 ± 0.04; 243.40 ± 0.04, E2 + <4%M1; 372.08 ± 0.06 and 453.83 ± 0.05; while those in ^{127}I are 57.60 ± 0.02, M1 + (0.7 ± 0.1)%E2; 145.22 ± 0.03, E2 + <25%M1; 172.10 ± 0.03, M1 + <1%E2; 202.84 ± 0.03, M1 + (21 ± 3)%E2; and 374.96 ± 0.05, E2 + <30%M1. The γ rays associated with the ^{125}Xe decay were studied using (NaI(Tl)-NaI(Tl) coincidence techniques and Ge(Li) γ-ray spectrometers. Transitions of energies 511, 553.9, 635.8, 717.1, 726.8, 809.4, 819.3, 846.5, 901.5, 937.3, 992.5, 1007.5, 1021.5, 1075.3, 1089.9, 1108.5, 1138.4, 1181.0, 1193.6, 1253.6, 1318.3, 1327.9, 1383.7, 1442.1, and 1560.4 keV are seen in addition to the ones observed in internal conversion. Angular-correlation measurements verify that the 511-keV quanta result from positron annihilation. A ^{125}I level scheme is given which accounts for all transitions. The γ54.960−γ188.43 and γ54.960−e_K 188.43 angular correlations have been measured. The correlation results together with the measured transition multipolarities are consistent only with respective spin values of $^3/_2$ and $^1/_2$ for the 188.43- and 243.40-keV levels in ^{125}I. (auth)

35476 ANGULAR DISTRIBUTIONS OF GAMMA RAYS PRODUCED IN THE ^{89}Y(n,n'γ)^{89}Y REACTION. Buchanan, Patricia S. (Texas Nuclear Corp., Austin); Mathur, Suresh C.; Tucker, W. E.; Morgan, I. L.; Hudspeth, Emmett L. Contract AT(40-1)-2791. Phys. Rev., 158: 1041-9(June 20, 1967). (ORO-2791-18).

The differential cross sections for the production of γ rays from the ^{89}Y(n,n'γ)^{89}Y reaction were measured at incident neutron energies of 3.0, 3.25, 3.5, 4.0, 4.1, and 4.5 MeV. At the highest incident neutron energy, γ rays with energies of 0.71, 0.908, 1.31, 1.51, 1.62, 1.75, 1.95, 1.98, 2.10, 2.46, 2.58, 2.70, 2.86, 3.09, 3.49, and 3.85 MeV were observed. Angular distribution of these γ rays were measured at neutron energies of 3.25 and 4.0 MeV. The distributions were also calculated theoretically on the basis of the Satchler formalism using the computer program TRANSEC developed at this laboratory. A comparison between the experimental and theoretical cross sections has led to spin assignments for the 1.51-, 1.75-, 2.22-, 2.53-, 2.86-, 3.09-, and 3.49-MeV levels in the ^{89}Y nucleus. The γ-ray spectra indicate the existence of an excited level at 3.85 MeV. (auth)

35477 ANOMALOUS L-SUBSHELL CONVERSION COEFFICIENTS OF THE HIGHLY K-FORBIDDEN E1 TRANSITION IN ^{180m}Hf (5.5h). Scharff-Goldhaber, G.: McKeown, M. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Phys. Rev., 158: 1105-11(June 20, 1967). (BNL-10975).

The extremely K-forbidden E1 transition (8− → 8+) of 57.5 keV in ^{180m}Hf was long known to have an anomalously high ($L_I + L_{II}$) conversion coefficient. In order to resolve these two lines, the electrons emitted from an evaporated Hf_2O_3 source of ~50-μg/cm^2 thickness were analyzed in a double-focusing spectrometer. The values found for the conversion coefficients in the three-different L subshells are $\epsilon_{L_I} = 0.308 \pm 0.025$; $\epsilon_{L_{II}} = 0.067 \pm 0.010$; $\epsilon_{L_{III}} = 0.055 \pm 0.010$, as compared with Rose's theoretical values $\alpha_1(L_I) = 0.108$; $\alpha_1(L_{II}) = 0.047$; $\alpha_1(L_{III}) = 0.062$. No admixture of M2 or E3 components fits the experimental results. Of the two explanations for the anomaly considered, namely penetration effects and parity mixing, the second was excluded by the lack of circular polarization of the 57.5-keV γ rays (Bock, Jenschke, and Schopper; and Paul, McKeown, and Scharff-Goldhaber), while the first is compatible with our results. For the 8− → 6+ transition of 501.5 keV, more precise values of the branching ratio, energy, and K-conversion coefficient are obtained. Its L conversion coefficients were measured. The results are compatible with the mixing ratio reported by Bodenstedt et al.: 3.5%M2 + 96.5%E3. The $(L_I + L_{II})/L_{III}$ ratio of the 93.3-keV E2 transition is found to be somewhat lower than the values reported by other authors, but still anomalously high (1.28 ± 0.03, compared to the theoretical ratio of 1.11). A search for the 834-keV 8− → 4+ transition yielded an upper limit of 2×10^{-5} per day. The capture cross section of ^{179}Hf for thermal neutrons leading to the activation of ^{180m}Hf is found to be σ_{act}, $^{179}Hf_{th} = 0.34 \pm 0.03$b. The analysis of the resulting isomeric ratio $\sigma(^{180m}Hf)/\sigma_{tot} = 0.52\%$ leads to the conclusion that the spin of the capturing state for thermal neutrons in ^{180}Hf is predominantly 5. (auth)

35478 SEARCH FOR PARITY ADMIXTURE IN THE 57.5-keV GAMMA TRANSITION OF ^{180m}Hf. Paul H.; McKeown, M.; Scharff-Goldhaber, G. (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 158: 1112-17(June 20, 1967).

The possible explanation of the anomalous L-coversion coefficients of the 57.5-keV K-forbidden transition of ^{180m}Hf as due to a parity mixture (E1 + M1) would imply a circular polarization of the γ rays of 56%. By measuring the transmission of the radiation through a magnetized foil of Supermendur, a circular polarization of (5.9 ± 6.1)% was obtained. It is concluded that the anomaly found for the conversion coefficients is probably due to penetration effects. (auth)

35479 NEW MOESSBAUER LEVELS IN THE RARE EARTHS FOLLOWING COULOMB EXCITATION. Stevens, R. R. Jr.; Eck, J. S.; Ritter, E. T.; Lee, Y. K.; Walker, J. C. (Johns Hopkins Univ., Baltimore). Phys. Rev., 158: 1118-27(June 20, 1967).

By using Coulomb excitation to populate the excited states of the nuclei, new Mössbauer levels were observed in ^{160}Gd, ^{164}Dy, and ^{168}Er. Mössbauer levels were observed following Coulomb excitation in ^{155}Gd, ^{156}Gd, and ^{158}Gd. For the even-even isotopes of gadolinium, hyperfine structures are poorly resolved, but under appropriate assumptions relative quadrupole moments can be obtained which agree with the values derived from Coulomb excitation cross-section data. Well-resolved magnetic hyperfine structure was obtained in ^{168}Er, and the magnetic energy splitting of $(7.8 \pm 0.4) \times 10^{-6}$ eV was obtained. In the case of ^{164}Dy a well-resolved hyperfine structure was observed, but the interpretation of the complex structure was not definite. (auth)

35480 FISSION AND THE SYNTHESIS OF HEAVY NUCLEI BY RAPID NEUTRON CAPTURE. Bell, George I. (Los Alamos Scientific Lab., N. Mex.). Contract W-7405-eng-36. Phys. Rev., 158: 1127-41(June 20, 1967). (LA-DC-8513).

The role of fission is examined in the synthesis of heavy nuclei by multiple capture of neutrons in thermonuclear explosions. Evidence from the recent Tweed and Cyclamen experiments indicating that neutron-induced fission is a serious source of depletion in neutron capture chains which start from targets of ^{242}Pu and ^{243}Am is reviewed. An analysis of Tweed abundances is made to obtain capture-to-fission ratios for the odd-A plutonium isotopes through A = 253. The liquid-drop model of Myers and Swiatecki plus empirical shell corrections and pairing energies is then used in order to correlate and predict spontaneous fission lifetimes and fission barriers. For nuclei having Z ≤ 101 and N ≤ 157, the shell correction is extrapolated, assuming it to be a function of N plus a function of Z. Thus, neutron binding energies, fission barriers, and spontaneous fission lifetimes for neutron-rich heavy nuclei are obtained. Capture-to-fission ratios are estimated for many of these nuclei, and qualitative agreement is found with laboratory and Tweed results. The extrapolation is continued out to N = 159 and Z = 104. It is concluded that by using the liquid-drop model plus semiempirical shell corrections, one can obtain capture-to-fission ratios and spontaneous fission half-lives which are usefully accurate. However, for predicting properties of nuclei having Z > 104, N ≳ 159, one needs, in this formalism, an accurate way of predicting shell corrections or nuclear masses. (auth)

35481 ENERGY LEVELS OF $^{166}_{68}$Er AND $^{166}_{69}$Tm (7.7 h) EXCITED IN THE DECAY OF $^{166}_{67}$Ho (26.7 h), $^{166m}_{67}$Ho (1.2 × 10^3 yr), AND $^{166}_{70}$Yb (57 h). Burson, S. B. (Instituut voor Kernphysisch Onderzoek, Amsterdam. Argonne National Lab., Ill.); Goudsmit, P. F. A.; Konijn, J. Phys. Rev., 158: 1161-81(June 20, 1967).

The γ-ray spectra accompanying the decay of $^{166}_{67}$Ho (26.7 h), $^{166m}_{67}$Ho (1.2 × 10^3 yr), $^{166}_{70}$Yb (57 h), and $^{166}_{69}$Tm (7.7 h) were examined with Ge(Li) detectors. Chemically purified sources of ^{166}Yb revealed only the known 82.3-keV transition in ^{166}Tm. Nine transitions observed in the 26.7-h ^{166}Ho activity fit known excited levels in ^{166}Er: 80.57 (2$^+$), 786.4 (2$^+$), the 1460.9-keV (0$^+$) β-vibrational state, and two higher levels at 1663.0 (1$^+$), and 1830.5 keV (1$^-$). Forty-two of the 63 transitions observed in the spectrum of 1.2 × 10^3-yr ^{166m}Ho are assigned among 14 excited states in ^{166}Er; these states are at 80.57 (2$^+$), 265.0 (4$^+$), 545.4 (6$^+$), 911.2 (8$^+$), 859.9 (3$^+$), 956.4 (4$^+$), 1075.4 (5$^+$), 1216.3 (6$^+$), 1376.1 (7$^+$), 1556.1 (8$^+$), 1666.5 (5$^-$), 1693.0 (5$^-$), 1787.3 (6), and 1828.1 keV (5,6). The first four levels are members of the K = 0 ground-state rotational band. The next six states are members of the K = 2 γ-vibrational band based on the 786.4-keV band head. Approximately 90 γ rays are resolved in the Ge(Li) spectrum of ^{166}Tm. These, together with a summary of the results of internal-conversion measurements made previously by other investigators, are listed in a table containing 110 transitions believed to occur in the ^{166}Tm decay. Approximately 80 of these γ rays were placed into 23 excited states in ^{166}Er. The energies (keV) of these states are 80.57 (2$^+$), 265.0

(4^+), 545.4 (6^+), 786.4 (2^+), 859.9 (3^+), 956.4 (4^+), 1075.4 (5^+), 1375 (2^+), 1458.9 (3^-), 1514.5 (3^-), 1530.1 (2^+ or 3^+), 1572.4 (4^-), 1704 (3^+ or 4^+), 1918.6 (3^-), 1940, 2134.4 (3^+), 2161.2 (3^+), 2174.4 (3^+), 2243, 2274, 2292, 2679, and 2728. The 1530- and 1704-keV states may be the 2^+ and the 4^+ levels of the β-vibrational band based on the 1460.9-keV (0^+) band head. A study of the γ-ray spectrum in coincidence with annihilation radiation (in triple coincidence) indicates that the two reported positron branches of 1932 keV (1% per disintegration) and 1210 keV (0.3% per disintegration) decay to the 80.57- and to the 786.4-keV levels, respectively. Comparison of the relative γ-transition intensities between members of the γ-vibrational band and various members of the ground-state rotational band yield a value of the mixing parameter $z = 0.045 \pm 0.003$. The rotational E2 transition rates relative to the vibrational transition rates are calculated, yielding a mean value of 45.5 ± 3 for the ratio. The energy values of the members of the ground-state and γ-vibrational bands are compared with the usual expansion in $I(I + 1)$. The third-order term $CI^3(I + 1)^3$ is believed necessary to describe both bands. (auth)

35482 K/(L + M + ...) RATIO OF THE 355-keV TRANSITION IN ^{133}Cs. Hendrick, L. D.; Avignone III, F. T. (Univ. of South Carolina, Columbia). Phys. Rev., 158: 1181-3(June 20, 1967).

The K/(L + M + ...) internal-conversion ratio for the 355-keV transition in ^{133}Cs was measured to be 4.27 ± 0.13. Interference of K-shell electrons from the 382-keV transition was eliminated by standard fast-slow coincidence techniques using pulses from a Si(Li) detector at 77°K and NaI(Tl) scintillator. The experimental result indicates the multipolarity of the 355-keV transition to be (97.5% E2, 2.5% Max M3) when compared with existing tabulations of internal-conversion coefficients (ICC) compared with predictions made using Coulomb-screened ICC calculations, a predominantly M3 multipolarity is implied. In either case no M1 contribution is evidenced, and the spin of the 436-keV level is verified to be $\frac{1}{2}^+$, allowing this level to be interpreted in terms of the shell model as a single-particle excitation to an $s_{\frac{1}{2}}$ state. (auth)

35483 DECAY SCHEMES OF THE ^{119}Te ISOMERS. Graeffe, G. (Massachusetts Inst. of Tech., Cambridge); Hoffman, E. J.; Sarantites, D. G. Contracts AT(11-1)-1530; AT(30-1)-905. Phys. Rev., 158: 1183-93(June 20, 1967). (MIT-905-74).

The decays of the 4.7-day ^{119m}Te and the 16-h ^{119g}Te were investigated with the use of Ge(Li) and NaI(Tl) γ-ray detectors, and Si(Li) electron detectors. Coincidence relations among the γ rays were determined in $\gamma-\gamma$ coincidence experiments. It was established that the decay of the 4.7-day ^{119m}Te populates levels at 270.6, 1048.3, 1212.7, 1249.6, 1365.8, 1406.7, 2129.3, 2226.0, 2277.8, 2283.6, and 2360.4 keV in ^{119}Sb and that the decay of the 16-h ^{119g}Te populates levels at 270.6, 644.3, 700.0, 1338.5, 1413.2, 1487.4, 1749.5, and 1821.0 keV in ^{119}Sb. Many spin assignments were made from present and previously reported internal-conversion-electron data, from log ft values, and from $\gamma-\gamma$ directional correlation measurements. Trends of the low-lying levels of odd-A antimony isotopes from mass 119 to 125 are discussed and are compared with the pairing-plus-quadrupole model for nuclei. (auth)

35484 ELASTIC AND INELASTIC PROTON SCATTERING FROM ^{107}Ag AND THE PHONON-CORE MODEL. Ford, J. L. C. Jr.; Wong, Cheuk-yin; Tamura, Taro; Robinson, R. L.; Stelson, P. H. (Oak Ridge National Lab., Tenn.). Phys. Rev., 158: 1194-1205(June 20, 1967). (ORNL-P-2871).

The elastic and inelastic scattering of 12.94-MeV protons from ^{107}Ag was studied. Angular distributions were measured between the angles of 24 and 165° for particles scattered from the ground state and excited states at 0.324, 0.423, 0.780, 0.950, 1.14, 1.28, 1.50, 1.66, and 2.19 MeV. The magnitudes and shapes of the angular distributions are compared with the predictions of the core-excitation model. For the states which appear to be due to coupling of an odd proton to the one-phonon quadrupole and octupole states of the even core, the experimental cross sections are fitted by means of the distorted-wave Born approximation. Differential cross sections of the states attributed to excitation of the one- and two-quadrupole phonon states of the even core were compared to the predictions of the coupled-channel theory with the assumption that only a $p_{\frac{1}{2}}$ proton is coupled to the core. Reasonable agreement between experiment and theory was obtained, provided an admixture of one- and two-quadrupole phonon 2^+ states was allowed. The knowledge of the derived core-state wave functions is used to evaluate the electromagnetic transition probabilities between some of the states, and they are found to be in general accord with those known from Coulomb excitation and γ-ray experiments. (auth)

35485 THERMAL-NEUTRON-CAPTURE GAMMA-RAY STUDIES OF THE EXCITED STATES OF ODD-A HAFNIUM ISOTOPES. Namenson, A. I.; Bolotin, H. H. (Argonne National Lab., Ill.). Phys. Rev., 158: 1206-13(June 20, 1967).

A lithium-drifted germanium detector was used to investigate the primary high-energy γ rays following thermal-neutron capture in the even-A isotopes ^{176}Hf, ^{178}Hf, and ^{180}Hf. The energies, intensities, and isotopic assignments of many of these transitions were determined. The primary transitions from the capture state to the low-lying Nilsson states in ^{179}Hf and ^{181}Hf were found to exhibit regularities which appear inconsistent with a wholly statistical capture model. These results, together with similar findings of other investigators for the cases of ^{183}W, ^{185}W, and ^{187}W, are discussed in terms of both the statistical model and evidence suggestive of operational selection rules which appear to govern the radiative decay of the capture states. In addition, six previously unreported transitions were observed and were assigned to the reaction ^{177}Hf $(n,\gamma)^{178}$Hf. (auth)

35486 LEVEL STRUCTURE OF ^{106}Pd. Bakhru, H. (Yale Univ., New Haven); Preiss, I. L. Phys. Rev., 158: 1214-21 (June 20, 1967).

The decay of 8.1-day ^{106}Ag produced in the ^{103}Rh$(\alpha,n)^{106}$Ag and ^{107}Ag$(n,2n)^{106}$Ag reactions was studied with lithium-drifted Ge detectors and standard scintillation spectrometers. The level structure of ^{106}Pd was found to be much more complex than previously reported. Twenty-five-ray transitions from 0.200–2.08 MeV have been observed to decay with half-life of 8.1 days. The transitions with intensities greater than 1% of the 0.512-MeV transition decays have the following energies and transition intensities: 0.221 (9), 0.278 (11), 0.345 (12), 0.400 (4), 0.410 (10), 0.430 (8) 0.450 (19), 0.512 (100), 0.616 (25), 0.650 (10), 0.720 (37), 0.750 (25), 0.800 (5), 0,810 (20), 0.830 (26), 1.04 (24) 1.08 (1.5), 1.12 (10), 1.2 (8), 1.22 (5), 1.52 (7), 1.57 (4), 1.66 (≈1), 1.72 (≈1), and 1.83 (≈1). Gamma-gamma coincidence studies with the help of Ge detectors confirmed previously unreported levels at energies of 1.34, 3.25, and 3.31 MeV in ^{106}Pd. Sum-coincidence studies were performed; based on these results, the level structure of ^{106}Pd is given and is discussed in the light of the vibrational model. The half-life of the 2.94-MeV level was measured by delayed-coincidence technique to be $2 \pm 0.5 \times 10^{-7}$ sec. (auth)

35487 GAMMA-GAMMA ANGULAR CORRELATION IN ^{182}W. Mangal, P. C.; Trehan, P. N. (Panjab Univ., Chandigarh, India). Curr. Sci. (India), 36: 337-8(July 5, 1967).

The angular correlations of 68–1222, 264–68, and 222–1231 keV cascades were studied using a conventional fast-slow coincidence arrangement with an effective resolving time of about 70 nsec and two 3 in. × 3 in. NaI(Tl) crystals. The results support spin assignments of 2, 3, and 4 for the 1289-, 1331-, and 1554-keV levels. It was also concluded that the 1231-keV gamma ray is pure E2 in character. (D.C.W.)

35488 INTEGRAL MEASUREMENTS OF THE EPITHERMAL NEUTRON CAPTURE-TO-FISSION CROSS-SECTION RATIOS OF ^{233}U AND ^{235}U. Conway, D. E.; Gunst, S. B. (Bettis Atomic Power Lab., West Mifflin, Pa.). Nucl. Sci. Eng., 29: 1-6(July 1967). (WAPD-T-1900).

Samples of uranium enriched in ^{233}U and in ^{235}U were irradiated with cobalt monitors in high-flux facilities in both cadmium-covered and bare assemblies. Radiometric analyses of irradiation samples provide data concerning thermal and epithermal capture and fission reactions from which experimental results are obtained. The epithermal capture-to-fission cross-section ratios of ^{233}U and ^{235}U at infinite dilution are 0.175 ± 0.006 and 0.499 ± 0.016, respectively, for a 1/E spectrum with a low-energy cutoff of 0.50 eV. Resonance integrals for capture and fission are evaluated in terms of cobalt cross sections. (auth)

35489 THRESHOLD DETECTOR CROSS-SECTION INTERCALIBRATION IN A PURE FISSION SPECTRUM. Bresesti, A. M.; Bresesti, M.; Rydin, R. A. (CCR-EURATOM, Ispra, Italy). Nucl. Sci. Eng., 29: 7-14(July 1967).

Intercalibrated values of fission-spectrum-averaged cross sections were obtained for the ^{24}Mg (n,p), ^{46}Ti (n,p), ^{54}Fe (n,p), ^{56}Fe (n,p) ^{58}Ni (n,p), ^{59}Co (n,α), ^{92}Mo (n,p), and ^{115}In (n,n') threshold reactions. All values are given relative to an assumed value of 0.61 mb for ^{27}Al (n,α) ^{24}Na. Irradiations were performed in a specially designed Converter Facility, located in a beam port near the thermal column of the Ispra-I Reactor. The converter is a disk of enriched uranium-aluminum alloy suspended in an essentially material-free cavity. Spectral purity correction factors were calculated using the Monte Carlo code TIMOC. The measured values are compared to the results of other workers. (auth)

35490 THE EFFECTIVE RESONANCE INTEGRAL AND DOPPLER COEFFICIENT OF THORIUM-OXIDE RODS. Hardy, J. Jr.; Palowitch, B. L. (Bettis Atomic Power Lab., West Mifflin, Pa.). Nucl. Sci. Eng., 29: 111-21(July 1967).

The effective resonance capture integral of ThO_2 was measured at temperatures of 300 and 1200°K for rods ranging in diameter from 0.4 to 3.0 cm. The measurements were done by an activation

technique relative to the dilute resonance integral of thorium. Calculated resonance integrals obtained using current cross sections and calculational methods are found to be in good agreement with the experimental results. (auth)

35491 NEUTRON-CAPTURE CROSS SECTION OF 35-hr ^{105}Rh. Glendenin, L. E.; Griffin, Henry C. (Argonne National Lab., Ill.). Nucl. Sci. Eng., 29: 147-8(July 1967).

The neutron capture cross section of ^{105}Rh was measured by irradiating targets of ^{105}Rh in the pneumatic tube of the Argonne CP-5 reactor, with subsequent selective coincidence counting of the 2.2-hr isomer of ^{106}Rh. The weighted average of the cross-section values obtained is 5.7 ± 1.2 kb. (D.C.W.)

35492 BENT CRYSTAL SPECTROMETER MEASUREMENT OF THE INTENSITIES OF X RAYS COINCIDENT WITH FISSION OF ^{235}U. Wehring, Bernard William. Urbana, Ill., Univ. of Illinois, 1966. 110p.

Thesis.

A measurement of the intensities of K x rays from fission fragments was made. The experiment was a coincidence experiment ($2\tau \approx 0.10$ μsec) and only those x-rays in coincidence with a fission event were counted. Since the energy of the characteristic x-ray is determined by the nuclear charge of the primary fragment, a study of the prompt x-ray spectrum gives information about the initial charge distribution of the fission fragments. A bent-crystal spectrometer of the Johansson type was designed and constructed. A unique arm mechanism permits the source to remain fixed as the Bragg angle is changed. This mechanism is also somewhat simpler than other existing bent crystal spectrometer mechanisms. The crystal assembly of the spectrometer consists of 6 single crystals of LiF which were cleaved, bent, bonded onto a single plate and ground to the correct curvature. In order to maintain sufficient sensitivity, resolution was sacrificed. The resolution, however, was still good enough to resolve the K_α lines of adjacent elements. A wire coated with 6 ± 2 mg/cm^2 of enriched uranium placed in a thermal neutron beam served as the fission source. This wire was both the center wire for a fission ionization chamber and the x-ray source for the bent crystal spectrometer. Although the sensitivity of the spectrometer was one or more orders of magnitude greater than other dispersive x-ray spectrometers, the time required to obtain data was relatively long. The background problems were also severe. The results of the measurement lend support to the "neck model" of nuclear fission where nuclear shell structure determines the scission shape. The dominant mechanism for K vacancy production appears to be the internal conversion process during the de-excitation of deformed fragment nuclei. In addition to the K x-rays of the fission fragments, L x-rays of uranium were also detected. (Disser. Abstr.)

35493 THE ^{208}Pb(d,t)^{207}Pb REACTION WITH 15 TO 25 MeV DEUTERONS. Muehllehner, Gerd. Ann Arbor, Mich., Univ. of Michigan, 1966. 74p.

Thesis.

Experimental work was done to determine the absolute differential cross-sections for the (d,t) reaction on ^{208}Pb corresponding to transitions to single particle levels in ^{207}Pb for incident deuterons in the energy range from 15 to 25 MeV and to determine the set of parameters in the DWBA calculations that give the best fit to the measured differential cross-sections. The reaction ^{208}Pb(d,t)^{207}Pb is well suited for this purpose in as much as ^{208}Pb has a closed shell in both protons and neutrons and therefore the low lying levels excited in the (d,t) reaction should correspond to pure single particle hole states. Given the set of parameters the method can then be used to extract spectroscopic information from measured differential cross-sections for reactions in other nuclei in this mass region where other than single particle transitions are involved. Deuterons from the University of Michigan 83-in. cyclotron were used to measure absolute differential cross-sections at 14.8, 20.1, and 24.8 MeV for six single particle levels in ^{207}Pb and for elastic scattering of deuterons on ^{208}Pb. The level at an excitation energy of 3.42 MeV was identified as the $h_{\frac{9}{2}}$ single particle state. The reaction products were analyzed in energy with a magnetic spectrometer and recorded either with a sonic spark chamber or in nuclear emulsion or with a plastic scintillator and photomultiplier. The DWBA calculations were performed at the Oak Ridge National Laboratory using the Julie computer code. The DWBA calculations were performed for several values of the bound neutron parameters a, R_0, and λ, several values of the triton distorted wave parameters W_0 and R_0', and different forms of the interaction. It was found that the measured distributions could be matched well with the calculated distributions in shape as well as absolute cross-section. The only major discrepancy was found for the $i_{\frac{13}{2}}$ at the lower energies and at forward angles. Changing the triton parameters W_0 and R_0' affects the shape of the distributions at the forward angles, particularly for the $i_{\frac{13}{2}}$. It was necessary to vary W_0 with energy in order to obtain equally good fits to the absolute cross-section at all three energies. The neutron parameters a and R_0 were found to affect the absolute cross-section only. Calculations which included corrections for finite range and non-local effects did not improve the fit to the absolute cross-section. Using the best set of parameters determined, it was found that the shape of the calculated angular distributions agrees well with the measured distributions. The absolute differential cross-sections differ by as much as 28%. It is concluded therefore that the DWBA analysis will be useful in extracting l-values and spectroscopic factors in the heavy mass region for deuterons of energy 15 to 25 MeV. (Disser. Abstr.)

35494 PROPERTIES OF THE LOW LYING STATES IN ^{99}Ru AND ^{101}Ru, INCLUDING THE LIFETIME AND MAGNETIC MOMENT OF THE 127 keV STATE IN ^{101}Ru. Connors, Phillip Irving. University Park, Pa., Pennsylvania State Univ., 1966. 76p.

Thesis.

The properties of the low lying states of ^{99}Ru and ^{101}Ru populated in the β-decay of their parents were studied and compared to the predictions of de Shalit's core excitation model. The states in ^{101}Ru fed by the decay of ^{101}Rh ground state (~5 yr) were studied by both electron and gamma ray spectroscopy. Three transitions were found (gamma ray intensities in parenthesis): 127.2 ± 0.2 keV (93); 198.0 ± 0.3 keV (100), and 325.2 ± 0.5 keV (21). The absolute K-conversion coefficients of the 127.2 and 198.0 keV transitions were measured to be 0.14 ± 7% and 0.040 ± 7% respectively. The angular correlation coefficient of the 198.0 – 127.2 keV transitions was determined to be $A_2 = 0.22 \pm 10\%$. The half life of the 127.2 keV state was found to be 0.63 ± 0.03 nsec. When combined with the Coulomb excitation data of Ritter et al., the M1-E2 mixing ratio, δ^2, of the 127.2 and 198.0 keV transitions are 0.023 ± 0.005 ($\delta > 0$) and ≤0.06 ($\delta < 0$), respectively. This gives a unique spin sequence for the excited states: 127.2 keV ($\frac{3}{2}^+$) and 325.0 keV ($\frac{1}{2}^+$). The log ft value for the feedings of the 127.2 and 325.2 keV states are 9 and 7.5 respectively. When the 127.2 keV transition was compared to single particle speeds the M1-part was retarded by a factor of 70 ± 1 and the E2-part enhanced by 18 ± 3. The magnetic moment of the 127.2 keV state was determined using the perturbed angular correlation technique ($\mu = -0.11 \pm 25\%$ nm). The decay of the 157.4 keV isomeric state of ^{101}Rh was also studied. The following transitions were found (gamma ray intensities in parenthesis): 127.2* keV (10), 157.4*(2.4), 180(8.5), 184.3*(1.5), 234(2), 238(2), 306.7*(≡1000), 545.4*(38). Those transitions with an asterisk were also seen in conversion electron studies. The 157.4 keV is the isomeric transition in ^{101}Rh and its K/L-ratio is 2.9 ± 10%. This combined with a crude measurement of $\alpha_K \approx 20$ shows this to be an M4 transition. Coincidence studies show states at 0, 127.2, 306.7, 311.5, and 545.4 keV. K-capture feeding was found to the 306.7 and 545.4 keV states with log ft values of 5.3 and 6.2 respectively. The study of the decay of the 16 day state of ^{99}Rh was limited to the four prominent low lying excited states whose energies were found to be 89.6, 322.4, 442.7, 618.7 keV. All transitions between these states were seen in gamma ray studies and their gamma-ray intensities measured. All possible gamma-ray coincidences were seen and confirm this level scheme. Conversion electron lines were seen for the 89.6, 322.4, 353.1 and 528.7 keV transitions. The 89.6 keV transition was found from studies of the L-subshell conversion electron lines to be (66 ± 7)% E2 and (34 ± 7)% M1. Positron–gamma-ray coincidences were used to determine the β-decay feeding of these states and log ft values (state energy in parenthesis) of 8.8(89.6), 8.0(442.7), and 7.5(618.7). No direct feeding was found to the 332.4 keV state. The total β-decay energy was measured to be 2.11 ± 0.25 MeV. From the log ft values and gamma-gamma angular correlations the following spin sequence is found g.s.($\frac{5}{2}^+$), 89.6($\frac{3}{2}^+$), 322.4 (probably $\frac{1}{2}^+$ or $\frac{3}{2}^+$), 442.7($\frac{5}{2}^+$), and 618.7($\frac{1}{2}^+$ or $\frac{3}{2}^+$). A shorter-lived decay of ^{99}Rh was also briefly investigated and found to have a half life of 4.9 ± 0.3 hours. Many low energy (<800 keV) transitions were found and their gamma intensities measured. (Disser. Abstr.)

35495 THE USE OF A SOLID-STATE DETECTOR FOR CONVERSION ELECTRON SPECTROSCOPY AND A STUDY OF THE RADIOACTIVE DECAY OF ^{97}Ru. Gillespie, Claude Milton Jr. Columbus, Ohio, Ohio State Univ., 1966. 116p.

Thesis.

A conversion electron spectrometer employing a Li-drifted Si detector was designed and built. The spectrometer may be operated with the detector cooled to dry-ice temperature or at room temperature. The resolution cooled is about 6 keV and at room temperature about 9.5 keV. Variable source-detector spacing permits solid angles in the range 24 to 0.064% of the total sphere. Data are given on five calibration standards giving thirteen points on the energy calibration curve between 23 and 656 keV. Corrections to the energies of the standards to account for electron energy loss in the detector window and to account for peaks having

several unresolved components are given. The operating characteristics of the spectrometer including linearity, drift, background, and noise are discussed. The measurement of conversion ratios is discussed, and expressions are derived to correct the conversion electron peak areas for summing between the conversion electrons and other coincident radiation such as x rays and Auger electrons. Conversion ratios for the calibration standards are measured and compared with the best known values. The comparison indicates that conversion ratios can be measured to an accuracy of 10% or better. Several techniques for measurement of conversion coefficients are considered. The most successful technique is one in which the gamma-ray and conversion-electron spectra are obtained separately, but, under similar conditions, with the silicon detector. To obtain the gamma-ray spectrum alone, the electrons are selectively absorbed with a Be absorber. The conversion coefficient is determined from the gamma-ray and conversion-electron count rates with the detector efficiency taken into account. The energy-dependent detector efficiency is determined from measurements on the calibration standards for which the conversion coefficients are known. Under favorable conditions it appears that conversion coefficients can be measured by this technique to an accuracy of about 15%. The electron-capture decay of ^{97}Ru was studied. Sources of ^{97}Ru were made by neutron irradiation of ruthenium metal enriched to 95% in ^{96}Ru. Gamma-ray and conversion electron spectra were obtained with lithium drifted germanium and silicon detectors respectively, and gamma-ray coincidence spectra with scintillation detectors. Transitions assigned to the decay of ^{97}Ru are observed at energies of 109 ± 1, 177 ± 5, 216 ± 1, 325 ± 1, 462 ± 2, 569 ± 2, 642 ± 4, and 751 ± 3 keV. Conversion coefficients of several transitions were measured. Based on these data the following levels in ^{97}Tc are proposed: 215 ± 1 keV ($\frac{7}{2}^+$), 325 ± 1 keV ($\frac{5}{2}^+$), two levels between 782 and 788 keV, and 967 ± 3 keV. From the gamma-ray and conversion-electron intensities transition probabilities are calculated. After substantially complete decay of the ^{97}Ru, electrons from the 97-keV isomeric transition in ^{97}Tc were observed. The total transition probability to this level is 0.03 ± 0.01. (Disser. Abstr.)

35496 ALPHA–GAMMA ANGULAR CORRELATION IN ^{233}U. Trojan, Oleh Alexander. Toronto, Univ. of Toronto, 1966.

Thesis.

The alpha-gamma angular correlation in ^{233}U was measured using an extended source. The source was prepared by electrodeposition of uranium oxide to a thickness of 1.2 mg/cm^2 over an area of 1 in. dia on an aluminum backing. Calibration of the equipment was achieved by comparing experimental alpha-gamma angular correlation results in ^{226}Ra (extended source) with the theoretical correlation modified by attenuation coefficients as reported by other researchers. It was found that the first excited state of ^{229}Th de-excites by pure M1 radiation (>99%) with a half-life less than 1.9 nanoseconds. The second excited state of ^{229}Th was found to de-excite by E2 crossover radiation in at least 96% of the cases, and predominantly by M1 cascade radiation in the remaining events. From experimental coincidence measurements, an upper limit of 0.61 ± 0.05 ns was set for the half-life of the first excited state of ^{222}Rn. This upper limit corresponds with the actual half-life reported for this state. Prompt coincidence curves were unwrapped out of the coincidence curves using different time constants for the first excited state of ^{222}Rn. These prompt coincidence curves were used to extract the half-life of the second excited state of ^{229}Th out of the alpha-gamma coincidence curve for ^{233}U. The half-life for this state was found to be $0.66 \pm {}^{0.03}_{0.11}$ ns. An isotropic alpha-gamma angular correlation was found involving the alpha decay of ^{233}U to the first excited state of ^{229}Th. This result is in agreement with calculated correlation expressions using an intensity ratio of 36:1 for the L = 2,4 alpha partial angular momentum waves as obtained from the Bohr, Fröman and Mottelson semi-empirical formula. Using a ratio of 5.7:1 for the relative transition probabilities of L = 2,4 alpha partial waves leading to the second excited state of ^{229}Th, the theoretical unattenuated angular correlation expressions were found to be $W(\theta) = 1 + 0.263 P_2 + 0.064 P_4$ for L = 2,4 partial waves in phase, and $W(\theta) = 1 + 0.442 P_2 - 0.218 P_4$ for L = 2,4 partial waves out of phase with each other. The experimental results for this correlation show an anisotropy at zero time of 0.025 ± .025 between 180° and both 90° and 135°. These results indicate that in uranium oxide a time dependent perturbation with a precession time of 0.2 ± .2 ns was causing the destruction of the anisotropy. It is postulated that the random in time perturbations of the intermediate spin state are caused by fluctuations in the hyperfine I – J coupling between the nucleus and the excited electron shell. However, the angular correlation results do not support with any certainty either of the two possible phase choices between the L = 2,4 alpha partial angular momentum waves. (Disser. Abstr.)

Nuclear Theory

Refer also to abstracts 34389, 35406, 35408, 35418, 35419, 35421, 35424, 35425, 35428, 35429, and 35462.

35497 (ANL–7320, pp 245-6) THEORY OF THE NEUTRON STRENGTH FUNCTION. Azziz, Nestor (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.).

A model that describes the nuclear structure of the compound nucleus ^{59}Ni is briefly explained. Some gross nuclear parameters, as neutron strength function and imaginary part of the optical potential, are discussed. Predictions from the model are then used to estimate the values of these parameters. (auth)

35498 (BNL–50002) TABLES OF ELECTRON WAVEFUNCTIONS AND ASSOCIATED DATA. Church, E. L. (Brookhaven National Lab., Upton, N. Y.). Dec. 1966. 119p. Dep. CFSTI.

The role of the penetration effect in internal conversion is reviewed, and a collection of formulas for the analysis of such effects in the K and L shells is provided. Tables of the bound and free electron wave functions at the nucleus, which appear as normalization constants, are given. These results, which include the effects of the finite nuclear size and atomic screening, are derived from the tabulations of Band, Guman, and Sogomonova, which represent intermediate steps in the internal-conversion-coefficient calculations of Sliv and Band. (auth)

35499 (FEI–67) UGLOVAYA ANIZOTROPIYA I EFFEKTY PARNOI KORRELYATSII NUKLONOV PRI DELENII YADER NEITRONAMI. (Angular Anisotropy and the Effect of Nucleon Pair Correlation During the Fission of Nuclei by Neutrons). Smirenkin, G. N.; Nesterov, V. G.; Tishin, A. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1966. 30p. (In Russian). Dep.

The energy dependence of the angular anisotropy of the fission of ^{233}U, ^{235}U, and ^{239}Pu with neutrons and of ^{233}U with α particles was discussed. In conformance with the statistical theory of the angular distribution of the fragments, the dependence of the mean square of the projection of the moment of the compound nucleus on the fission axis $\overline{K^2}$ on the excitation energy E at the saddle point was obtained. The analysis of the dependence $\overline{K^2}(E)$ made it possible to determine for ^{240}Pu at the deformed surface the state of the critical energy as $E_{cr} = 9.5 \pm 3$ MeV from which originated the transition from the superfluid phase to the normal and the size of the energy gap in the spectrum of the internal excitation as $2\Delta_0 = 1.5 \pm 0.3$ MeV. The values obtained were significantly lower than the last data on these magnitudes. It was shown that the rate of regression to the Fermi gas model was dependent on the effects of the correlation of the nucleons and was significantly lower than was assumed earlier. (tr-auth)

35500 (JINR–P2-3356) MEKHANIZM VZAIMODEISTVIYA BYSTRYKH DEITRONOV S YADRAMI. (Mechanism of Interaction of Fast Deuterons With Nuclei). Barashenkov, V. S.; Gudima, K. K.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1967. 18p. (In Russian). Dep.

A method of calculation of inelastic collisions of deuterons with nuclei is suggested. The calculation is made by the Monte Carlo method taking into account the Coulomb and diffraction deuteron splittings. The results of calculations agree well with experiment. (auth)

35501 (RFK-559) ELECTRON RADIAL WAVE FUNCTION FOR POSITRON BETA DECAYS. Buehring, Wolfgang (Heidelberg Univ. (West Germany). Zweites Physikalisches Institut. Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Apr. 1967. 5p. Dep.

It is pointed out that the tables of electron radial wave functions by Bhalla and Rose are incorrect as far as positrons are concerned. (auth)

35502 (NP–16777) O VYCHISAENII SECHENII N VYKHODOV YADERNYKH REAKTSII PRI SREDNIKH I BOL'SHIKH ENERGIYAKH I TORMOZHENII ZARYAZHENNYKH CHASTITS V VESHCHESTVE. (Calculation of Cross Sections and Yields of Nuclear Reactions for Average and High Energies and Bremsstrahlung of Charged Particles in Matter). Maksimov, M. Z. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1965. 168p. (In Russian). Dep.

The goal of the study was the derivation of analytical expressions as a function of the energy of the incident particles. As the result of interaction with the electrons of the matter, scattering by the Coulomb field of the nuclei, excitation and ionization of the atoms, the particles are stopped, resulting in energy losses and reduction of the reaction cross section. Thus, the reactions occur

primarily within a thin layer. In order to determine the thickness of this layer, the specific energy losses of the charged particles in the matter must be known. The stoppage of charged particles and their disintegration by the Coulomb field of the nucleus is reviewed, calculating the cross sections and yields of (d,p), (d,n) reactions in the medium incident-particle energy range, examining also the possibility of increasing the reaction product yield by using thin targets. At the high energy range, the intranuclear cascade problem was investigated. This was followed by a review of the representation of the density of the nucleus and its potential by means of analytical functions which may be used to calculate the cross section of the interaction of particles with nuclei. The coefficient of transparency of the nucleus was correlated to the cross section of interaction of fast nucleons with nuclei; the interaction of deuterons and tritons with nuclei was also examined. (Dissertation) (TTT)

35503 (RT/FI-(67)10) A FORTRAN PROGRAMME FOR THE COUPLED-CHANNEL CALCULATION OF THE NEUTRON SCATTERING FROM ROTATIONAL EVEN-EVEN NUCLEI. Fabbri, F.; Saruis, A. M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1967. 39p. Dep.

The program DANGFASI, which can be used to calculate the elastic scattering phase shifts, cross sections, and polarization for neutrons on even-even rotational nuclei using the coupled-channel method, is described. The mathematical formulation of the program, which is in FORTRAN IV for the IBM 7094, is presented. (D.C.W.)

35504 (UJV-1834) WAVE FUNCTIONS FOR MIXED CONFIGURATIONS AND THE RACAH ALGEBRA OF SU(4) GROUP. Kukulin, V. J.; Majling, L.; Smirnov, Yu. F. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). May 1967. 20p. Dep.

A new method of construction of many-nucleon wave functions with a given Young tableau for two unfilled shells is described. The Racah algebra of the SU(4) group is employed for obtaining the many-particle coefficients of fractional parentage as well as calculations of matrix elements of one- and two-particle operators. (auth)

35505 (LA-tr-67-36) "SHELLS" IN DEFORMED NUCLEI. Strutinskii, V. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). Translated by Helen J. Dahlby (Los Alamos Scientific Lab., N. Mex.), from report IAE-1350. 70p. Dep. CFSTI. JCL $6.60 fs, $2.30 mf.

The effects of shells in deformed nuclei are discussed including shell corrections to the energy and shell density of nucleon levels correlation of the shell correction to the energy and shell density of upper nucleon levels, the distribution of nucleon shells in deformed nuclei, equilibrium deformations of nuclei, the transition between spherical and nonspherical equilibrium shapes, second minima of the deformation energy, and anomalies in the masses and fissionability of nuclei. The predictions of the single-particle model are compared with calculations using the shell-correction method. (D.C.W.)

35506 OPTICAL-MODEL ANALYSIS OF THE REACTION CROSS SECTION. Pascual, Ramon; Carbonell, F. Vicente (Facultad de Ciencias, Valencia). An. Real Soc. Espan. Fis. Quim. (Madrid), Ser. A, 63: 229-32(July-Aug. 1967).

The dependence of the reaction cross section on the nuclear mass number A was studied by means of the optical model. The validity of an experimental graphical method that has been proposed before by Villar is confirmed. (auth)

35507 NUCLEAR FORCES AND EFFECTIVE INTERACTIONS IN NUCLEI. Akaishi, Yoshinori; Takada, Kenjiro (Kyoto Univ. Osaka City Univ.). Progr. Theor. Phys. (Kyoto), 37: 847-69(May 1967).

Local effective interactions in nuclei are calculated by using the reference spectrum method for four types of nuclear forces: the Hamada-Johnston potential, one of the Tamagaki-Wada-Watari potentials in the ^3E state, the Brueckner-Gammel-Thaler potential, and the Gaussian-type soft-core potential proposed by Tamagaki. Matrix elements necessary for the shell model calculations in 1p-shell nuclei are also calculated and compared with the results of the analyses given by Cohen and Kurath (CK) and the study group of Kirin University (KU). Because of "the off-energy-shell effect," strengths of hard core spikes of the effective interactions for the nuclear forces with hard core are considerably larger than that of Brueckner, Gammel and Weitzner. There appear many discrepancies between derived matrix elements and those of CK and KU. (auth)

35508 DECAYING STATE AND RESONANCE SCATTERING. Ohmura, Takashi (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto), 37: 813-30(May 1967).

The scattering phase shift in the neighborhood of an isolated resonance is expressed in terms of three parameters, or more accurately, four parameters. The first two parameters are the resonance energy and the widths. The other parameters represent the background phase shift (namely, the phase shift far from the resonance level), which determines the "shape" of the scattering cross section. It is shown that these parameters are completely determined by the decaying-state wave function through its complex energy eigenvalue (the position of the S-matrix pole) and a complex "effective range" (or the complex residue) of the decaying state. Another type of resonance scattering at low energies is also discussed in terms of the (real) energy eigenvalue and the (real) effective range of the virtual state. For bound states the situation is similar: the residue of the negative hydrogen ion H^- (the bound state in the electron-hydrogen atom scattering system) is evaluated by using accurate values of the binding energy of the H^- state and its effective range. (auth)

35509 THE GALILEAN AND TRANSLATIONALLY INVARIANT OPERATOR ALGEBRA DESCRIBING NUCLEI. II. DISCUSSION OF THE COMMUTATION RELATIONS. Seyfferth, Siegfried (Univ., Goettingen, Ger.). Z. Phys., 204: 155-63 (1967).

The deviation of the commutation relations of the Galilean and translationally invariant field operators (given in part I) from the exact Fermi commutation relations is investigated. For this purpose the invariant field operators are integrated with one-particle functions describing a compact n-particle system of nucleons and its low excitations. With this assumption an approximate expression for the (subtractive) deviation of both commutation rules from one another is given. It is carefully estimated that the exact deviation, taken in the operator norm, is of order $n^{-\frac{1}{3}}$. It is shown that the degree of compactness of nuclear matter in the phase space plays an essential role in the determination of this estimate. (auth)

35510 A NEW APPROACH TO POTENTIAL SCATTERING. PART III. IMPROVEMENT CONCERNING UNITARITY. Krueger, H. (Univ., Freiburg i. B.). Z. Phys., 204: 114-21(1967).

Potential scattering calculations based on Calogero's equation and given in two former papers are improved to include unitarity of the S matrix. It is shown that the method gives results better than the second Born approximation and even reasonable in the two limits of very strong coupling and very low energies. As test examples, the square-well potential and the Yukawa potential are discussed. (auth)

35511 EXCHANGE CONTRIBUTION IN THE ELASTIC SCATTERING OF alpha-PARTICLES BY LIGHT NUCLEI. Quesne, C.; Willain, C. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy Belg. (5), 49: 1156-64(Nov. 9, 1963). (In French).

The elastic scattering differential cross section of α particles by α nuclei described in the α model was calculated in the plane-wave Born approximation. It is shown that, when the target nucleus is ^{8}Be and the range of the interaction between α particles is zero, the contribution of the heavy-particle stripping mode is very small in comparison with those of the direct and knock-out processes, so that the total differential cross section is forward peaked. (auth)

35512 EMPIRICALLY DETERMINING THE INTERNAL CONVERSION COEFFICIENTS OF PURE E2-TRANSITIONS. Rakovitskii, S. L. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 75-6(1966). (In Russian).

The value of the internal conversion coefficient (ICC) depends on the energy of the transition E_γ, the atomic number Z, the shell from which the conversion electron originates, the multipolarity of the gamma radiation, and the character of the nuclear transition (electric or magnetic). It is of interest to have an empirical formula for calculating internal conversion coefficients (ICC). Tabulated ICC values from Sliv and Band were plotted as a function of $(Z/E_\gamma)^2$, and the following empirical formulas were derived: $\alpha_K(E2) = 6.8\ (Z/E_\gamma)^3 + 2.4 \times 10^{-4}$ at $(Z/E_\gamma)^3 < 1.5 \times 10^{-4}$, and $\alpha_K(E2) = 4.05\ (Z/E_\gamma)^3 + 3.7 \times 10^{-4}$ at $1.5 \times 10^{-4} < (Z/E_\gamma)^3 < 10^{-4}$. These empirical ICC values also agree with the tabulated values of Rose at $26 < Z < 90$ and gamma transition energies of 300 keV $< E_\gamma <$ 1200 keV. The maximum error is 10%. (TTT)

35513 ANGULAR DISTRIBUTION OF SECONDARY PARTICLES FORMED BY THE INTERACTION OF FAST NUCLEI WITH NUCLEI OF THE PHOTOEMULSION. Azimov, S. A.; Rasulkulov, M. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 46-50(1966). (In Russian).

A statistical method of confirming the normal behavior for the angular distribution with any number of shower particles n_s is presented. An empirical average value of $\bar{x}$ and a variance dispersion s^2 are assumed for n_s statistically independent and nor-

mally distributed random values of $x_i = \lg \operatorname{tg} \theta_i$. The ratio of the empiric, average absolute deviation to the empiric standard value is defined as W and is taken as a criterion of normal distribution of $x_i = \lg \operatorname{tg} \theta_i$. The expected mean and the dispersion of W are respectively: $M(W) = \lambda/s_1$ and $D(W) = M[W^2 - M^2(W)] = [(1 + n_s - 1)\lambda^2]/n_s - \lambda^2/s_1^2$. Here $\lambda = \sqrt{2/\pi}$ and $s_1 = \exp(-1/4n_s)$. The random term α is introduced: $\alpha = [W - M(W)]/\sqrt{D/W}$. This term has a mathematical expectation of zero and a dispersion of one independent of the distribution parameters of x_i. A total of 25 alpha showers with $n_s > 20$ was selected to investigate the angular distribution form. The angles of the shower particles with respect to the direction of motion of the primary alpha particle were measured twice in some cases in order to exclude pair formation and random traces. It was found that $\bar{\alpha} = 0.54$, and it was concluded that these showers did not show a normal distribution or statistical independence in values of x_i. A similar analysis that the azimuthal angular distribution of secondary shower particles was isotropic and independent of the azimuthal angle. (TTT)

35514 REGULARIZING THE SET OF EQUATIONS FOR THE PROCESS $\pi + N \rightarrow 2\pi + N$. Islamov, M. F. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 60-3(1966). (In Russian).

The set of singular integral equations is written for the reaction: $\pi + N \rightarrow 2\pi + N$. It is shown that the property of crossed symmetry can be applied to give explicitly a kernel and an inhomogeneous member of the regular equation. The problem of equivalence is solved, and it is demonstrated that the set of singular integral equations is equivalent to a set of Fredholm equations and a set of supplementary, conditional equations. (TTT)

35515 ERICSON FLUCTUATIONS IN NUCLEAR REACTIONS. Magda, M. T. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 19: 375-428(1967). (In Rumanian).

The statistical model identifies nuclear reactions on the basis of the mean values of the measurable reaction cross sections, making use of the information concerning the formation of compound nuclei in the region of the continuum. The fluctuation theorem developed by Ericson and Brinck makes it possible to carry out a complete analysis of the system, complementing the findings obtained by means of the old statistical model; it is thus not a new model. Application of the theory helped to calculate the mean nuclear widths, from which the mean lifetime of the excited nuclei in the region of the continuum could be derived; this is of great interest for separating various types of reactions. Fluctuation measurements also contributed to the theory of the strongly excited state, including level-density and moment-of-inertia determinations. 105 references. (TTT)

35516 POLARIZATION EFFECTS IN NUCLEAR STATISTICAL REACTIONS. Gadioli-Erba, E.; Sona, P. G. (CISE, Milan. Univ., Milan). Energ. Nucl. (Milan), 14: 419-22(July 1967).

A discussion is given on the simplest type of experiments useful for detecting the effects of a polarization of the primary beam on the statistical fluctuations of nuclear reaction cross sections. (auth)

35517 TOTAL MUON-CAPTURE RATE AND THE CONSISTENCY OF MIGDAL'S THEORY. Rho, Mannque (Univ. of Virginia, Charlottesville). Contract AT(40-1)-2915. Phys. Rev. Lett., 19: 248-51(July 31, 1967). (ORO-2915-78).

Migdal's theory of nuclear structure is recast in the shell-model language, enabling one to show that the excellent agreement with experiment of the theory applied to the total muon-capture rate is obtained by an appreciable symmetry breaking of the Wigner's SU(4) supermultiplet structure contrary to other models where the symmetry seems to be well preserved. Thus, the μ-capture result is inconsistent with the dipole photoabsorption and inelastic electron scattering processes reflecting the possible breakdown of the quasiparticle hypothesis. (auth)

35518 SOME RATIONAL APPROXIMATIONS FOR THE BICKLEY FUNCTIONS K_{in}(n = 1, 2, 3, 4, 5). Makino, Kakuji (Tokyo Shibaura Electric Co., Ltd.). Nukleonik, 9: 351-2(Apr. 1967).

The Bickley functions $K_{in}(x)$ defined by $K_{in}(x) = \int_0^{\pi/2} d\Theta \cos^{n-1}\Theta \exp(-x \sec \Theta)$ occur in the calculation of first-flight collision probabilities in cylindrical and two dimensional geometry. Approximations for these functions are tabulated for n = 1, 2, 3, 4, 5 to save calculation and storage time in computer calculations. (S.F.L.)

35519 QUADRUPOLE EFFECT OF POLARIZED NUCLEI ON ELASTIC SCATTERING. Kim, Y. N. (Texas Technological Coll., Lubbock). Phys. Rev., 158: 984-6(June 20, 1967).

It is shown that for $\eta \equiv Z_1 Z_2 e^2/\hbar v \gtrsim 4$, the deviation from Coulomb scattering is determined more or less uniquely by η in the quadrupole elastic scattering of charged particles by polarized nuclei. The dependence on the mode of damping of the wave function for $\eta \leq 4$ is also discussed. (auth)

35520 MODEL CALCULATION OF NUCLEAR INELASTIC EFFECTS ON HIGH-ENERGY LEPTON PAIR PRODUCTION. Smith, H. P.; Malenka, B. J. (Northeastern Univ., Boston). Phys. Rev., 158: 1011-17(June 20, 1967).

The contributions to lepton pair production due to single-particle quasielastic nuclear excitations are calculated using the second-quantization technique of Czyz. The nucleus was approximated as a gas of noninteracting nucleons and the nucleon current was expanded to terms of the order of q^2/M^2. Numerical results are given for the case of pair production which is symmetric in energy and angles with a purely Coulomb interaction. (auth)

35521 ORTHOGONAL CLASSIFICATION OF ALPHA-PARTICLE WAVE FUNCTIONS. Beam, John E. (Univ. of Wisconsin, Madison). Contract AT(11-1)-Gen-7. Phys. Rev., 158: 907-16(June 20, 1967). (COO-7-407).

A four-nucleon wave function has four parts: spin (S), isospin (T), angular-momentum (L), and internal (I), combined into a totally antisymmetric function. The nonrelativistic α-particle ground state is described by 32 independent internal functions. Cohen, using an overcomplete set of 34 internal functions, has previously classified the α-particle ground state into three $^1S_0$, eight $^3P_0$, and six $^5D_0$ states, not all mutually orthogonal (or even independent). With the help of the concept of S independence, a grouping of the 32 independent internal functions into an orthogonal and complete set of three $^1S_0$, six $^3P_0$, and five $^5D_0$ states is described. (auth)

35522 HARTREE–FOCK CALCULATIONS WITH REALISTIC HARD-CORE POTENTIAL. Pal, M. K.; Stamp, A. P. (Massachusetts Inst. of Tech., Cambridge). Contract AT(30-1)-2098. Phys. Rev., 158: 924-40(June 20, 1967). (MIT-2098-332).

The effective matrix elements of the two-nucleon Yale potential were used in doing Hartree–Fock (HF) calculations in N = Z even nuclei ($8 \leq A \leq 40$). The ground-state energy and single-particle energies and wave functions were calculated as a function of two deformation parameters. The calculated equilibrium shapes and binding energy per nucleon are found to be reasonably good. The difficulties in the HF formalism due to the state dependence on the reaction matrix were discussed, and methods were suggested for doing a fully self-consistent calculation of the reaction matrix elements and the Hartree–Fock energy and states. (auth)

35523 THREE-BODY CORRELATIONS IN NUCLEAR MATTER. II. Bethe, H. A. (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 158: 941-7(June 20, 1967).

The contribution of three-body correlations to the energy of nuclear matter is formally calculated. This is necessary to get numerical results from the three-body wave function of Day and Kirson. The potential energy for "particle" states is redefined. This definition, as well as other results, differs from previous ones. (auth)

35524 A-DEPENDENCE OF NUCLEAR CHARGE AND MASS DISTRIBUTIONS. Elton, L. R. B. (Univ. of Surrey, London). Phys. Rev., 158: 970-3(June 20, 1967).

A discussion is given of the A-dependence of the root-mean-square radii of the nuclear charge and mass distributions both along and at right angles to the valley of maximum stability. In the second case, i.e., for isotopes and isotones, it is pointed out that the charge radii never obey an $A^{\frac{1}{3}}$ dependence even approximately, but that for mass radii the experimental evidence is not in conflict with such a dependence. Attention is also drawn to the differences between the distribution of proton centers and the charge distribution. (auth)

35525 SELF-CONSISTENT PERTURBATION OF HARTREE–FOCK–BOGOLIUBOV EQUATIONS AND NUCLEAR ROTATIONAL SPECTRA. II. Marshalek, Eugene R. (Univ. of Notre Dame, Ind.). Phys. Rev., 158: 993-1010(June 20, 1967). (COO-427-61).

The coefficient B, occurring in the angular-momentum expansion $E_I = AI(I + 1) + BI^2(I + 1)^2 + \ldots$ of the energy levels of the ground-state rotational band of even-even deformed nuclei, is numerically calculated on the basis of a microscopic model derived in a previous paper. Numerical estimates of the z factors, which measure the effect of band-mixing on γ-ray branching ratios from vibrational to ground-state bands, are also presented. (auth)

35526 TWO-NUCLEON EMISSION PROCESS IN π^--MESON ABSORPTION. Cheon, Il-tong (Kyoto Univ.). Phys. Rev., 158: 900-6(June 20, 1967).

The effects of the short-range N–N correlations on the branching ratio $W(pn \rightarrow nn)/W(pp \rightarrow np)$, on the distribution of the absorption rate with respect to the projection of the opening angle be-

tween the emitted nucleons, and on the total absorption rate in negative-pion absorption by ^{12}C nuclei are investigated. (auth)

35527 COMPUTATION OF TOTAL, DIFFERENTIAL, AND DOUBLE-DIFFERENTIAL CROSS SECTIONS FOR COMPOUND NUCLEAR REACTIONS OF THE TYPE (a,bγ) AND (a,bγ−γ). Sheldon, Eric; Gantenbein, Peter (Eidgenoessische Technische Hochschule, Zurich). Z. Angew. Math. Phys., 18: 397-433(May 25, 1967).

Two computer codes are described for the interpretation of low-energy scattering and reaction data for processes of the type (n,n'γ), (p,p'γ), (p,nγ), (n,pγ), (t,nγ), (t,pγ), (^{3}He,pγ), etc., in which spin-½ particles incident upon a target nucleus lead to a formation of a compound system which decays by emission of spin-½ particles. The codes contain provision for the consideration of arbitrarily high orbital angular momenta of incident and emergent particles, and arbitrarily many extra exit channels from the compound nucleus. The consideration of particle transitions can include the effects of spin-orbit interaction, and that of γ-ray transitions and multipole mixing. Provision is also made for including the effects of an unobserved intermediate transition (which can be of mixed multipolarity), since this is of use in the determination of cascade contributions to the cross section. In using compatible input data, the programs at present offer a greater degree of flexibility and generality than other commensurate codes. Extension to include the effect of level-width fluctuations is under consideration. The theory underlying the codes is discussed. (S.F.L.)

35528 QUASI-SPIN METHODS AND PAIRS OF ONE-PARTICLE CFP IN THE SENIORITY SCHEME. Innes, Frederick R. (Cambridge Research Labs., Bedford, Mass.). J. Math. Phys. (N. Y.), 8: 816-20(Apr. 1967).

The use of creation and destruction operators to form irreducible tensors in quasi-spin (triple tensors) is advanced to give the important points of the seniority scheme for linear and bilinear forms (CFP, matrix elements, and products). A number of such forms as studied by Racah and others are taken up with emphasis on cases diagonal in the seniority number, v. Values of CFP for seniority v + 1 can then be determined from those of seniority v − 1. The possibilities in quasi-spin are explored to give a number of additional formulas for products of two CFP. Also, Redmond's formula and some specializations of it are found in the seniority scheme and their properties worked out. The calculation of CFP in the seniority scheme by these formulas is described and comparison made with other methods. (auth)

35529 IMPROVED NUMBER CONSERVING TREATMENT FOR A NUCLEAR PAIRING MODEL. Iwamoto, Fumiaki; Onishi, Hiroshi (Tokyo Univ.). Progr. Theor. Phys. (Kyoto), 37: 682-91(Apr. 1967).

Bardeen, Cooper, and Schrieffer's theory is improved with respect to particle number conservation so as to be applicable to nuclear spectroscopy. An asymptotic series in the inverse power of state number is derived in a simple way. Even the first order correction term gives a satisfactory numerical result. (auth)

35530 MOMENTUM SPACE CALCULATIONS OF NONSTATIC EFFECTS OF THE OPEP IN THE TRIPLET EVEN STATE. Wada, Masanobu (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto), 37: 763-4(Apr. 1967).

The differences between the ps- and pv-coupling cases and the estimation of the nonstatic effects of the OPEP in ^3E are investigated using momentum-space calculations. The results are used to exclude ambiguities from previous work on the triplet even state ^3E. (L.B.S.)

35531 PION EXCHANGE EFFECTS IN NUCLEAR WEAK INTERACTIONS. Cheng, Wen-Kwei. Philadelphia, Univ. of Pennsylvania, 1966. 81p.

Thesis.

A systematic account of the PE effects in the nuclear weak interactions is developed on the basis of a definite specification of the underlying effective weak-interaction and effective strong-interaction Lagrangians. In the framework of the V−A current-current Lagrangian theory of weak interactions, the conserved polar-vector current hypothesis is explicitly assumed so that the PE effects present only in the axial-vector current. Under certain physically plausible assumptions, it is then shown that the physical interpretation of PE effects in nuclear beta-decay becomes more transparent if these PE effects are described in terms of four dominant PE mechanisms: π-N*($J^P = 3/2^+$, I = 3/2), π-N*(3/2$^-$, 1/2) π-N*(1/2$^+$, 1/2) and π-ρ exchange. The corresponding PE hadron weak current operators $\underset{\sim}{A}^{exch.}(\pi\text{-}X)$ (X = N*(3/2$^+$, 3/2), N*(3/2$^-$, 1/2), N*(1/2$^+$, 1/2) and (ρ) and $A_6^{exch.}$ (π−ρ) are all obtained from first principles and expressed in terms of known parameters, i.e., the neutron-proton weak axial-vector coupling constant, strong coupling constants and hadron masses, using Goldberger−Treiman type relations derived on the basis of the partially conserved axial-vector current hypothesis and the pion-pole dominance assumption. The $\underset{\sim}{A}^{exch.}(\pi\text{-}X)$ induce PE corrections to "allowed" nuclear beta-decays while the $A_6^{exch.}$ (π−ρ) induces PE corrections to "parity first-forbidden" nuclear beta-decays. The structure of $\underset{\sim}{A}^{exch.}(\pi\text{-}X)$ is consistent with that of the most general phenomenological PE weak current operator previously obtained on symmetry grounds by Bell and Blin-Stoyle. A comparison of the present theory with the theory of Blin-Stoyle, Gupta and Primakoff and the theory of Blin-Stoyle and Papageorgiou is also given. The expression is tested for the PE contribution in the case of ^3H beta-decay. It is shown that the PE correction to the conventionally calculated $^3H \rightarrow {}^3He$ Gamow-Teller matrix element squared, corresponds to an enhancement ≅20% which is in essential agreement with the "best" experimentally based estimate of this quantity (an enhancement ≅16%). It is therefore believed that at least a semi-quantitative insight is attained into the long standing discrepancy between the conventional theory of nuclear beta-decay and experiment in the decisive cases of ^3H beta-decay where the nuclear wave functions are especially well known. The question of possible extensions of the present theory to the treatment of the PE effects in other nuclear weak interactions and in nuclear electromagnetic interactions is discussed. (TSS) (Disser. Abstr.)

35532 MAGNETIC MOMENTS AND REALISTIC FORCES. Mavromatis, Harry Anthony. Princeton, N. J., Princeton Univ., 1966. 138p.

Thesis.

The ground state magnetic moments of 23 odd-A nuclei were calculated using first-order perturbation theory. Of these, 21 are one nucleon (or hole) from closed j-j shells, and 2 nuclei have slightly more complicated configurations. Previous calculations of this type are improved by using realistic two-body forces obtained from nucleon-nucleon scattering and bound-state data, rather than using arbitrary nuclear residual two-body interactions. The procedure followed to obtain two-body matrix elements in finite nuclei from realistic two-body forces is outlined. Accurately known energy denominators are used in many cases. Results are in fair agreement with experiment. This indicates that with realistic forces configuration mixing accounts for much of the inward deviation from the Schmidt lines. For three $p_{\frac{1}{2}}$ nuclei the corrections are small, while for δ function residual interactions the corrections are zero. For several nuclei, including ^{29}Si and ^{209}Bi results with first-order perturbation theory fall short of the actual measured moments by more than half a nuclear magneton. Using realistic forces, the ground state magnetic moments of 8 odd-A nuclei which can have no first-order corrections to their moments are calculated. These nuclei are one nucleon (or hole) from closed j-j and L-S shells. This is done with the aid of second-order perturbation theory and diagrammatic techniques. It is shown that under certain restrictions the second-order corrections to the zero-order moments (Schmidt values) are equal and opposite for mirror pairs. For the hole nuclei the corrections are outwards, while for the particle nuclei they are inwards from the Schmidt lines. Second-order corrections are found to be significant but they do not invariably improve agreement with experiment. The matrix elements of $\sigma\tau_0^{(1)}$ are investigated for A = 15, 17, 39 and 41. Agreement with experiment is improved by the calculations in all cases. Also studied are ^{29}Si and ^{209}Bi to second order. The second-order corrections are smaller than and go in the opposite direction from the first-order ones. Finally, the 3$^-$ and 5$^-$ T = 0 vibrations are coupled in ^{40}Ca (treated as 1 particle-1 hole excitations) to single-particle states. This is considered part of the ^{41}Ca ground state wavefunction. With this wavefunction the −1.91 n.m. Schmidt value is reduced by about 0.05 n.m. Magnetic moments of vibrations are briefly examined and they are found to have gyromagnetic ratios of approximately a half. (TSS)

35533 MODEL FOR THE STUDY OF THE INTERFERENCE OF NUCLEAR REACTION MECHANISMS. Ratcliff, Keith Frederick. Pittsburgh, Univ. of Pittsburgh, 1965. 106p.

Thesis.

The nature of the interference of the direct and compound nucleus reaction mechanisms is investigated for inelastic scattering processes. The two mechanisms are considered on an equal basis; neither mechanism is treated as a small correction to the effect of the other mechanism. The continuum eigenfunction is written as a sum of product functions which characterize the open channels, and of localized functions which represent the compound states. The coupling of open channels to each other by the nucleon-nucleus interaction characterizes the direct reaction mechanism. The compound nucleus mechanism is characterized by the coupling of open channels to the localized states. Coupled differential-integral equations are derived for the nucleon-nucleus relative motion in each channel. These equations are reduced to algebraic

equations in the surface transition model, which assumes the coupling to be restricted to one radius. An expression is derived for the collision matrix in terms of two completely independent matrices which have a one-to-one correspondence with the two reaction mechanisms. The form of the collision matrix bears a strong resemblance to that used in R-matrix theory. It is suggested that this expression may be useful in phenomenological analyses of experimental data. The close similarity of the formal procedure to that used in Feshbach's unified theory is discussed in detail. (Disser. Abstr.)

35534 DWBA THEORY OF ^{3}He-INDUCED REACTIONS LEADING TO THREE-BODY FINAL STATES. Coker, William Rory. Athens, Ga., Univ. of Georgia, 1966. 54p.

Thesis.

Little experimental or theoretical work has been done on reactions of the type (^{3}He, xx'), where x and x' are a pair of nucleons. The fair success of a plane wave Born approximation (PWBA) stripping calculation, due to Duncan et al., in describing neutron angular and momentum distributions of the reaction ^{7}Li(^{3}He,np)^{8}Be, has led to a distorted-wave Born approximation (DWBA) calculation. Expressions are obtained for the angular and momentum distributions of a single nucleon, assuming a stripping process, ignoring spin-orbit coupling, and using either the point-nucleus approximation or the local energy approximation. (TSS)

35535 STUDIES OF CORE-PARTICLE MODELS OF THE NUCLEUS. Rinard, Phillip Martin. Manhattan, Kan., Kansas State Univ., 1966. 105p.

Thesis.

A model of nuclei consisting of an excited core with one extra particle is developed in terms of parameters resulting from the use of an interaction of a general nature between the core and particle. Consequences of the expressions for energy levels, static moments and transition rates are discussed separately and then the whole model is fitted onto three nuclei. The results of this fit for ^{197}Au indicate that this nucleus may be thought of as a core-plus-one particle nucleus although it has three protons outside closed shells. Measured quantities that are well determined are well accounted for whereas the more obscure values of the transition rates are more difficult to draw conclusions from. These results are compared to those obtained by other investigations. An extension of this model is sought by considering two particles outside a core. One expression of the interactions among these three bodies is found to have a special case already studied elsewhere but this form of the interaction is not readily generalized to more than two particles. So a different interaction is introduced and is the basis for the next more complicated core-particle model. Generalizing the preceding work to any number of particles outside a core, the particles are thought of as being each coupled to the core independently of the others and then allowance is made for two-body interactions between the particles. The energy levels of nuclei with "n" particles outside a core are expressed in terms of the energy levels of nuclei with one and two particles outside that same core. The parameters may be evaluated from the simpler nuclei and used in the more complicated nuclei as a test of the consistency of the model. This process is applied to two Au isotopes having Os isotopes as their cores. The core-particle interaction alone is found to be sufficient to form the gold states using values of the parameters obtained from iridium nuclei. An attempt to include particle-particle interactions in gold did not improve the core-particle interaction results due to the nature of the levels of the core-plus-two-particles nuclei which have even numbers of protons and neutrons. Since it has been seen that Au nuclei seem to be describable as either a core with one particle or as a core plus three particles, a connection between the two cases must exist. That connection is found to be due to the particular shell the three protons are occupying. (Disser. Abstr.)

REACTOR TECHNOLOGY

Central Power Reactors

Refer also to abstracts 34354, 34464, 34895, 34900, 35380–35383, 35667, 35669, 35692, 35694–35696, and 35718.

35536 (AAEC/E–173) THE SPACE DEPENDENT TREATMENT OF PEBBLE BED REACTOR FUEL MANAGEMENT USING THE BURNUP CODE FRIZLE. Hesse, E. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar. 1967. 42p. Dep.

An outline is given of the model used in the FRIZLE code complex in order to treat the two dimensional space dependent fuel management problem. The model is an extension of the zero dimensional burnup model, which allows the linking up of some existing codes. The code complex is capable of determining, for all envisaged pebble bed reactor fuel management schemes, the core power distribution based on the calculated average composition and temperature in specified core zones. The code is used for assessing several practicable management schemes applicable to a pebble bed reactor. These show that the same achievable burnup is obtained as with the zero dimensional method, based on the assumption of infinite recirculation. However, because of the markedly different core power distributions produced by various schemes, it is more important to arrange the management to reduce the core size and capital cost, than to increase burnup. Details of the 7040 (7 tape drives) code complex and data requirements are given. (auth)

35537 (AAEC/TM–375) REACTIVITY WORTH OF CONTROL RODS IN THE BERYLLIUM OXIDE MODERATED PEBBLE BED REACTOR. Spinks, N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1967. 13p. Dep.

Preliminary and final studies are reported for the worth of tubular control rods in BeO moderated pebble bed reactor systems. In the preliminary study the consideration of ball flow forces the investigation of a number of control rod arrangements. In addition a range of rod sizes is considered. In the final study a particular rod size and pattern is chosen for more detailed investigation. For the intermediate reactor cores under consideration the control rods must absorb appreciably in the keV region. A feature of the final study is the accurate way the epithermal absorption can be taken into account while using a three group model in the reflected reactor. The preliminary study is not so accurate but is useful for comparative purposes. (auth)

35538 (ACNP–67521) PATHFINDER ATOMIC POWER PLANT. XENON REACTIVITY TEST (335). Lacy, P. S.; Raby, T. M. (Allis-Chalmers Mfg. Co., Bethesda, Md. Atomic Energy Div.). June 1967. Contract AT(11-1)-589. 34p. Dep. CFSTI.

For Northern States Power Co., Minneapolis, Minn. and Central Utilities Atomic Power Associates.

The reactivity effect of Xe concentration in the Pathfinder reactor was measured at various reactor power levels from 40% of design power (76 MW(t)) up to and including 85% of design power (162 MW(t)). Measured data agreed well with calculations at the lower power levels and were slightly less than expected at the higher power levels. The latter is attributed mainly to the difference between calculations done for a voided unrodded core and measurements done for a nonvoided, rodded core. However, the control rod worth data generated during the test, from which the Xe worth was determined, also introduces a margin of uncertainty. The results indicate that the amount and distribution of voids present in the core have an appreciable effect on the magnitude and shape of the worth measurements. Based on results of measurements at the highest power level reached, it is estimated that at the full design power of 190 MW(t) equilibrium Xe will be worth approximately 2.7% Δk, and peak Xe will be worth about 5% Δk. This is approximately 10% less than the calculated values at full power of 3% Δk and 5.6% Δk, respectively. However, these extrapolations are based on measurements with a solid water reactor. It seems reasonable to expect that the effect of voids, if factored into the measurements, would yield higher measured values. Thus, it is recommended that the calculated values continue to be used. Good agreement was achieved between measurements and calculations in determining the worth of equilibrium Sm in the core. In both instances the worth of equilibrium Sm was established as 0.8% Δk. (auth)

35539 (AECL–2694) ZONE CONTROL ABSORBER EXPERIMENTS IN ZED-2. Kay, R. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1967. 27p. Dep. CFSTI. CAN $1.00.

It is proposed to use light water filled zone control absorbers in CANDU type power reactors. Measurements which were made when Al tubes of various diameters containing light water or air were placed interstitially in a simulated CANDU-BLW lattice in ZED-2 are described. Measurements were made of the detailed neutron density distributions in and about the perturbations and their relative reactivity effects on the lattice. The results of the experiments will provide a normalization for the computer codes used in the design of zone control absorbers in CANDU type reactors. (auth)

35540 (AEET–269) UTILIZATION OF THORIUM IN POWER REACTORS. Rastogi, B. P. (Atomic Energy Establishment, Trombay (India)). 1966. 26p. Dep.

The use of Th as a reactor fuel is discussed. The U resources are outlined; the availability and economics of the U supply is tabulated and compared to Th. The reactor physics aspects of Th are discussed. A comparison of power prototypes is presented; their performance is tabulated. A summary of Th reactor technology includes a list of all Th-fueled reactors and critical assemblies. 28 references. (M.L.S.)

35541 (AEEW-M–740) BURN-UP PREDICTIONS FOR GAS-COOLED, GRAPHITE-MODERATED REACTORS. Tyror, J. G. (Atomic Energy Establishment, Winfrith (England)). May 1967. 17p. (CONF-670418–2). Dep. CFSTI.

From IAEA Meeting on Fuel Burnup Predictions in Thermal Reactors, Vienna, Austria.

The theoretical approach currently in use for predicting the burnup characteristics of advanced gas cooled, graphite moderated reactors is outlined. Fuel burnup is computed using the ARGOSY code, with data derived from the UKAEA Nuclear Data Library; comparisons on a laboratory scale with measurements on samples taken from metal and oxide fuels show that Pu buildup, both in quantity and quality, is well understood. The most significant uncertainty in the theoretical approach is believed to be associated with predicting the variation in power distribution. (UK)

35542 (AEEW-M–750) SUPERNOVA: AN IMPROVED AND EXTENDED VERSION OF NOVA: A TWO DIMENSIONAL SPATIAL BURNUP CODE. Clarke, W. G. (Atomic Energy Establishment, Winfrith (England)). May 1967. 11p. Dep. CFSTI. UK.

SUPERNOVA calculates the spatial burnup in a reactor in two dimensions (or 3 dimensions in R-Z geometry) while varying the pattern of the control rods. The code will accept up to 40 neutron groups, giving as output the reactivity, power and burnup distributions at intervals throughout the life of the reactor. It is almost twice as fast as NOVA, while providing identical results. (UK)

35543 (AEEW-R–512) METHOD OF INFERRING K-INFINITY FROM REACTION RATE MEASUREMENTS IN THERMAL REACTOR SYSTEMS. Newmarch, D. A. (Atomic Energy Establishment, Winfrith (England)). May 1967. 34p. Dep. CFSTI. UK 4s. 6d.

A value for k-infinity is derived from measurements of reaction rate using common computational techniques and cross sections. The method provides an alternative to the classical approach using experimental bucklings with the criticality equation, the difference between the two methods being one of degree rather than kind. The method was developed for the analysis of SGHW-type lattices, but the underlying principles are generally applicable. The main weakness is the vulnerability to uncertainties in basic cross section data. (UK)

35544 (AEEW-R–515) QUAVER: A PROGRAMME TO EVALUATE MONOPOLE AND DIPOLE BOUNDARY CONDITIONS IN PRESSURE TUBE REACTOR LATTICES. Allen, F. R. (Atomic Energy Establishment, Winfrith (England)). Apr. 1967. 51p. Dep. CFSTI. UK 7s.

QUAVER calculates general multigroup monopole and dipole neutron flux boundary condition matrices at the fuel channel/moderator interfaces in pressure tube reactor lattices. Provision is made for in or out leakage of neutrons in each group at the cell boundary to allow for effects of cell environment on the channel boundary conditions. The program is written in EGTRAN for the KDF 9 computer. The theory of the method, the numerical method of solution, and the data input specification are described in detail. (UK)

35545 (AERE-R–4289) DESCRIPTION OF THE HOT NEUTRON SOURCE FOR DIDO. Egelstaff, P. A.; Moffitt, R. D.; Saunderson, D. H. (Atomic Energy Research Establishment, Harwell (England)). Nov. 1964. 17p. Dep. CFSTI.

The available neutron fluxes at 0.1 – 0.3 eV are too low for precise neutron scattering measurements. One method of in-

creasing the flux in this region is to bring the reactor spectrum into thermal equilibrium at a higher temperature so that its maximum is near 0.2 eV. The problem involved in doing this are discussed and two possible hot neutron moderator systems designed for the DIDO reactor are described. (auth)

35546 (ANL–7320, pp 3-14) STATUS OF BASIC NUCLEAR DATA REQUIRED FOR FAST BREEDER REACTOR DEVELOPMENT. Cox, S. A. (Argonne National Lab., Ill.).

The present precision and availability of nuclear data are discussed. Fission cross sections are examined in the light of recent ^{235}U measurement at A.W.R.E., Aldermaston. Since the ^{235}U fission cross section is used as a normalization standard for many cross-section measurements, its status is examined in detail. The normalization of neutron capture cross sections depends not only on the the ^{235}U fission cross section, but also on the $^{10}B(n,\alpha)$ cross section and measurements of spherical shell transmission. Each normalization procedure is discussed in detail. It is concluded that much of the existing disparity in results for fission and capture cross sections would be greatly reduced by a critical renormalization of all of the data to currently acceptable values of the ^{235}U fission cross section and the $^{10}B(n,\alpha)$ cross section. Recent re-evaluations of measurements of spherical shell transmission also tend to reduce the disparity. Neutron scattering cross sections from 0.3–1.5 MeV are in good shape. Because of the recent observation of intermediate structure in elastic neutron-scattering cross sections, measurements must be made in great detail especially below ~3–5 MeV. More data are needed from 1.5–5 MeV. Above 5 MeV the optical model can be used to interpolate between measurements rather widely spaced in energy. Recent $\bar{\nu}$ measurements confirm the nonlinearity of $\bar{\nu}$ vs E_n and also suggest the presence of an anomaly at ~0.4 MeV. Requests for nuclear data are examined according to the feasibility of the measurement and the man-year requirement necessary to achieve the requested precision. A list of 31 references is included. (auth)

35547 (ANL–7320, pp 216-30) ZEBRA 6: A DILUTE PLUTONIUM-FUELLED ASSEMBLY. Adamson, J.; Absalom, R. M.; Baker, A. R.; Ingram, G.; Pattenden, S. K. I.; Stevenson, J. M. (Atomic Energy Establishment, Winfrith (England)).

Zebra 6 was a Pu-fuelled fast reactor with natural U, graphite, and Na as diluents. The critical mass was 186 kg of ($^{239}Pu + ^{241}Pu$). Included is a selection of the measurements performed, including mainly techniques which will be important in the study of the PFR mockup. Thus the critical mass and the reactivity worth of Na, are discussed. Measurements of the neutron spectrum and the γ dose rate through the reactor are described. From perturbation and reaction rate measurements with ^{239}Pu and ^{10}B, the capture-to-fission ratio in ^{239}Pu is obtained. Because the reflector contained moderating material, having a composition nearly like uranium carbide, some attention is given to cross-section measurements in the reflector. The results are compared with calculations using diffusion theory with the FD2 multigroup cross-section set. (auth)

35548 (ANL–7320, pp 263-9) PRELIMINARY FAST REACTOR CROSS-SECTION SENSITIVITY ANALYSIS. Heck, F. M. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.).

An evaluation of the uncertainties in nuclear data for design of fast reactors is presented. Rapid estimation of effects of changes or or uncertainties can be made from the partial derivatives of reactor characteristics. These estimative methods are discussed. The data presented are preliminary. Their purpose was the evaluation of the partial derivative method for assessing reactor safety and economy. (M.L.S.)

35549 (ANL–7320, pp 270-5) USE OF INTEGRAL MEASUREMENTS AS SUPPLEMENTARY DATA IN NEUTRON CROSS-SECTION EVALUATION. Pazy, A.; Rakavy, G.; Reiss, Y.; Yeivin, Y. (Hebrew Univ., Jerusalem (Israel)).

The formulation of an exact method for improvement of microscopic cross-section evaluation by means of integral experiment data is presented. This formulation utilizes a generalized least squares method. A simple numerical example is used to illustrate the method. (M.L.S.)

35550 (ANL–7320, pp 304-15) ANALYSIS OF FAST REACTORS BY THE CIAP AND GLOBPERT CODES USING IMPROVED PERTURBATION METHODS. Gandini, A.; Salvatores, M.; Sena, G. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari); Dal Bono, I. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo).

In order to improve the analysis of fast reactors by the use of improved perturbation techniques, two codes have been developed which make use of the theory described by Usachev with respect to linear functionals of the neutron flux and extended to linear functionals of the neutron importance. The CIAP (Calculation of Importance for Analysis of Perturbations) calculates in one dimension and in multigroup diffusion theory the importance function to be used in the perturbation formulas relative to quantities such as reaction-rate ratios, reactivity coefficients, prompt-neutron lifetimes, and ratios of neutron source worth. The GLOBPERT Code has the features and requires the computing time typical of a conventional perturbation code. It uses the importance function given by the CIAP Code and calculates the fractional variation of reaction-rate ratios as functions of position and the fractional variation of reactivity values produced by any perturbation which changes or shifts the flux distribution. A few cross comparisons and applications of the codes are presented relative to two representative fast power systems. (auth)

35551 (ANL–7320, pp 334-40) DEPENDENCE OF THE DOPPLER COEFFICIENT OF REACTIVITY FOR HEAVY ELEMENTS ON CHEMICAL FORM, SURFACE-TO-MASS RATIO, AND NEUTRON SPECTRUM. Carpenter, S. G.; Mountford, L. A.; Springer, T. H.; Tuttle, R. J. (Atomics International, Canoga Park, Calif.).

A series of experiments has been carried out in a fast-neutron spectrum, characterized by a median fission energy of 62 keV, in order to measure the Doppler coefficient and other related temperature effects for a variety of materials which are of particular interest in fast power reactor technology. Special emphasis has been placed on the ^{238}U isotope which has been investigated in several chemical forms amenable to utilization in high-temperature, high-efficiency fuel elements. Changes in the size and chemical composition of samples of this isotope and other heavy-element isotopes have been made in order to evaluate the effects on the Doppler coefficient of changes in the surface-to-mass ratio and changes induced by the addition of C or O to form carbides and oxides. In addition, the effects of localized spectrum perturbation on the Doppler coefficient of Th have been studied by surrounding the sample with "blankets" consisting of heavy resonance absorbers, structural materials, and several types of scatterers, including Na. (auth)

35552 (ANL–7320, pp 341-4) DOPPLER COEFFICIENT MEASUREMENTS IN THE CRYOGENIC TEMPERATURE REGION. Mountford, L. A. (Atomics International, Canoga Park, Calif.).

The Doppler-coefficient has been measured in the cryogenic temperature range. The inverse temperature dependence of the coefficient results in relatively larger reactivity changes at low temperature, although crystalline binding effects begin to be significant in this range. The effective-temperature model has been used to correct for binding effects. The power fluctuations, as a sample was oscillated in and out of the reactor, were Fourier-analyzed to give the reactivity effect of the sample. Different sample temperatures were obtained using a "Cryo-Tip" refrigerator, which uses Joule-Thomson expansion of N and H to cool the sample. Measurements are reported for Th and W in a 62-keV median-fission-energy spectrum. Also included are measurements at higher temperature to cover the temperature range from 100 to 1000°K. The measured temperature dependence of the Doppler effects agree well with calculated values, with the crystalline binding effects being evident in W. (auth)

35553 (ANL–7320, pp 394-402) CALCULATION OF THE SODIUM-VOID AND DOPPLER REACTIVITY COEFFICIENTS IN FAST REACTORS AND CRITICAL ASSEMBLIES, WITH HETEROGENEITY TAKEN INTO ACCOUNT. Khairallah, A.; Storrer, F. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires).

A perturbation method, based on the use of collision probabilities in the transport operator, is presented for the investigation of the Doppler and Na-loss effects in a heterogeneous medium. The effectiveness of the method is first illustrated by its application to the homogeneous case, where it is shown to be superior to the conventional perturbation theory and to give results very close to those of exact calculations, even for large perturbations. Thus it is believed to give also correct results for the heterogeneous case. It is shown that heterogeneity decreases both the positive component of the Na-loss effect and the additional positive reactivity effect due to the change in the resonant-fuel "effective dilution" with Na loss, especially in metal-fueled crtical assemblies where heterogeneity is pronounced. In contrast, heterogeneity seems not to change appreciably the total Doppler effect, even though it may increase individual contributions of the fertile and fissile isotopes. The possibility is mentioned of applying this method to other reactivity effects which are proper to a heterogeneous medium such as the effect of radial expansion of the fuel on spatial self-shielding and self-multiplication. A list of 12 references is included. (auth)

35554 (ANL–7320, pp 439-46) APPLICATION OF SPACE–ENERGY SYNTHESIS TO THE INTERPRETATION OF FAST MULTIZONE CRITICAL EXPERIMENTS. Storrer, F.; Chaumont, J. M. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires).

Information gained from multizoned critical experiments is

rather difficult to interpret and to extrapolate with a multigroup theoretical model. A much simpler model involving only few parameters has been tried out which would still give a good representation of the physical processes. This simple model is based on a two-group formalism, in which the groups overlap, derived from the diffusion equation by a variational procedure. Comparison between conventional multigroup and two-overlapping-group formalisms gives excellent agreement. It is hoped that with the help of this method the interpretation of multizoned critical experiments might be greatly eased. It is also suggested that synthesis methods in general be used to solve some special problems in fast reactor physics. A list of 21 references is included. (auth)

35555 (ANL-7320, pp 421-8) STUDIES OF ANALYTICAL PROBLEMS IN INTERPRETATION OF ZONE-LOADING EXPERIMENTS, AND BASIC CONSIDERATIONS IN ZONE-LOADED CORE DESIGN. Fischer, G. J.; Travelli, A. (Argonne National Lab., Ill.).

The results of a study to explore the importance of some known computational difficulties in the analysis of zone loadings, and the predictions of major physical properties of a single-zone core from an analysis of its zone-loaded equivalent, are presented. The less obvious aspects of zone-loading design, of precautions necessary if misleading results are to be avoided, and of procedures or applications of zone-loading methods which could lead to meaningful experiments, are discussed. (M.L.S.)

35556 (ANL-7320, pp 429-38) PROGRESSIVE SUBSTITUTION METHOD IN FAST MULTIZONE EXPERIMENTS. Barberger, M.; Caumette, P.; Govaerts, P.; Storrer, F. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires).

The progressive substitution method has yielded good results when applied to the determination of material buckling in thermal reactors. It has been thought useful to investigate if this method could also be applied to fast reactors, in particular to the interpretation of fast multizone experiments. Preliminary results presented show that material-buckling differences between the reference and the substitution media can be obtained with good accuracy when the reflector saving does not vary during the substitution. If this is not the case, the interpretation of such experiments requires further work. A list of 10 references is included. (auth)

35557 (ANL-7320, pp 456-74) THE BALANCED OSCILLATOR TESTS IN SEFOR. Audoux, M.; Giordano, P.; Rohrbacher, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung); Caldarola, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik); Russell, C. (General Electric Co., San Jose, Calif. Advanced Products Operation).

In SEFOR, balanced oscillator tests will be performed to measure reactivity coefficients. Two types of balanced oscillator tests are planned: 1st Balanced Oscillator Test in which, while the coolant temperature is kept constant, the transfer functions between reactivity and power and between power and coolant flow are measured; 2nd Balanced Oscillator Test in which, while the reactor power is kept constant, the transfer function between reactivity and coolant temperature is measured. Particular effort has been devoted to studying possible ways of obtaining balancing conditions in the reactor plant. Two different types of control are being considered: 1. Open Loop Control in which predetermined input signals will be given to the reactor plant in order to hold constant the coolant temperature and the power. 2. Closed Loop Control in which the balance condition is reached with the aid of closed loop control. Both control methods are described and their performance characteristics are also analyzed. (auth)

35558 (ANL-7320, pp 605-28) STATIC PHYSICS MEASUREMENTS IN THE FERMI REACTOR. Mueller, R. E.; Nims, J. B.; Callen, R. C. (Atomic Power Development Associates, Inc., Detroit, Mich.).

Static physics measurements done in the Fermi Fast Breeder Reactor, at low power and in approaching full-power, are discussed. Emphasis, in the low power tests, is placed on those tests which can be compared with ZPR-3 critical experiment data. The results of measurements made to determine critical mass, reactivity worths of fuel and blanket materials, sodium worth, fission distributions, and control and safety rod worths are discussed. High power tests, including power- and flow-coefficient measurements, absolute power calibration data, and an observed reactivity decrease during power operation, are discussed. A list of 19 references is included. (M.L.S.)

35559 (ANL-7320, pp 629-52) REACTOR DYNAMICS MEASUREMENTS ON THE ENRICO FERMI REACTOR. Klickman, A. E.; Batch, M. L.; Paik, N. C.; Zaman, S. U. (Atomic Power Development Associates, Inc., Detroit, Mich.); Wilber, H. A. (Power Reactor Development Co., Newport, Mich.); VanDusen, B. D. (Chrysler Corp., Detroit, Mich.).

The characteristics of the reactor are measured by obtaining the reactor transfer function. Several methods have been used to do this. One consisted of the analysis of the response to a sinusoidal reactivity perturbation produced by a rotating oscillator rod; another consisted of the analysis of the response to both single and multiple trapezoidal reactivity pulses produced by the motion of a regulating rod. Experiments were done with the reactor at various power levels as well as with the reactor under both manual and automatic control. This permitted the determination of the zero-power transfer functions, the stability of the reactor, the feedback transfer function, and the control-system transfer function. The noise of selected signals such as ion chambers, thermocouples, and flowmeters have been recorded and analyses have been initiated. The auto-spectral density and cross-spectral density for two ion chambers have been determined as well as the frequency spectrum of the noise source. Certain important plant dynamics characteristics have been determined by measurement of the response of the plant to scheduled transients. The selected transients were a power-setback transient, a scram transient, an automatic approach to power, and shutdown of a single pump. A list of 10 references is included. (auth)

35560 (ANL-7320, pp 688-92) ERRORS AND OPTIMIZATION OF NEUTRON IMPORTANCE MEASUREMENTS. Tuttle, Robert J. (Atomics International, Canoga Park, Calif.).

The methods of measuring neutron importance are briefly discussed, and the errors arising in the use of the reactivity oscillator method are discussed in detail. Relative measurements with an accuracy of ±0.5% are shown to be feasible. Optimum reactivity conditions are derived. The application of this method to measurements of neutron importance in polyethylene-moderated test cells in a fast reactor test region is described and the results compared with theory. This comparison indicates faults in the calculational technique used. A list of 9 references is included. (auth)

35561 (ANL-7320, pp 714-23) THEORY OF FAST REACTOR INTEGRAL MEASUREMENTS BY PROPAGATION METHODS. Perez, R. B.; Denning, R. S.; Ohanian, M. J. (Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences).

The application of pulse propagation techniques to integral measurements for the determination of removal cross sections and the anisotropic moments of the scattering kernel in the few-MeV neutron-energy range is described. A new technique, which extends the B_N method to finite geometries, is introduced. The method is used to obtain the dispersion law for the complex inverse relaxation length of monoenergetic neutron waves in a non-multiplying and nonmoderating parallelepiped. Theoretical dispersion laws for 0.84- and 1.24-MeV neutrons in a Pb assembly and for 1.28-MeV neutrons in an Fe assembly are given. The removal cross section and moments of the scattering kernel are related to the coefficients of a power-series expansion of K^2 in terms of $i\omega$, where ω is the angular frequency. The sensitivity of these coefficients to the cross sections is shown. The advantages of measuring a complex eigenvalue K, rather than a real eigenvalue as in the case of the die away or static experiment, is discussed. Some results from a preliminary pulse propagation experiment for 2.14-MeV neutrons in Pb are shown to demonstrate that the technology to perform such experiments is presently available. A list of 9 references is included. (auth)

35562 (ANL-7320, pp 737-45) FUTURE UNITED STATES FAST REACTOR PHYSICS PROGRAM. Zartman, Ira F. (Division of Reactor Development and Technology (AEC), Washington, D. C.).

A review of the objectives and scope of the fast reactor physics program is presented. The Fast Breeder Reactor Program is detailed. A general discussion and evaluation of basic nuclear data are given. The theoretical and analytical tools used for fast reactor technology are discussed. The integral and critical experiments in use in the program are outlined. (M.L.S.)

35563 (ANL-7320, pp 746-57) RECENT DEVELOPMENTS IN THE SEFOR EXPERIMENTAL PROGRAM. Noble, L.; Pflasterer, G. R.; Wilkinson, C. D. (General Electric Co., San Jose, Calif. Advanced Products Operation); Caldarola, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik).

The objective of the SEFOR experimental program is to obtain reactivity-coefficient information that can be used to predict with confidence the kinetic behavior of large, fast, ceramic reactors. In order to obtain this information, three types of experiments will be performed: static tests, oscillator tests, and transient (including superprompt critical) tests. In the static tests, the power, flow, and inlet temperature can be changed in such a way that the reactivity effect associated with a change in fuel temperature due to power only, the coolant temperature coefficient, the combined power and temperature coefficient, and the flow coefficient can be determined. Three types of oscillator tests have been analyzed:

the conventional oscillator tests in which the reactivity-power transfer function due to the oscillation of a poison rod is determined; balanced oscillator tests in which the reactivity-power transfer function is determined for the case in which the relative phase and amplitude of a reactivity oscillation and a flow oscillation are adjusted so as to keep the coolant temperature constant; and balanced oscillator tests in which the reactivity-coolant temperature transfer function is determined for the case in which the reactivity and flow oscillations are adjusted so as to keep the power constant. Transient tests have been analyzed for various total reactivity worths and ejection rates at different power levels. Such tests allow the reactivity-energy coefficient to be determined over a wide range of fuel temperatures. A description of each test and of the power-temperature domain over which each test can be performed based on current SEFOR design capabilities is presented. Analytical models for the various feedback effects, together with recently calculated coefficients consistent with the SEFOR mockup tests in ZPR-3, are given. Methods developed for the evaluation of the feedback coefficients in the analytical model from the results of the static, oscillator, and transient tests are described. The proposed instrumentation, data-acquisition system, and data-processing techniques are also described. A list of 11 references is included. (auth)

35564 (APDA-193) QUARTERLY TECHNICAL PROGRESS REPORT ON AEC-SPONSORED ACTIVITIES, MARCH 15-JUNE 15, 1966. (Atomic Power Development Associates, Inc., Detroit, Mich.). Contract AT(11-1)-865. 107p. Dep. CFSTI.

Results of operation of the high-temperature Na-U paste flow loop are discussed. Testing of the moving settled-bed concept is described; results are outlined. An in-pile test loop design is given. The Small Leak Sodium-Water Reaction Test Program is discussed. Operations of the Sodium Technology Loop are detailed. Tabular summaries of rhometer data are presented. The sodium sampling procedure is given; data are tabulated. The design for the high-speed sodium centrifuge cleaning device is discussed. The results of tests on the solubility of hydrogen gas in sodium are presented. The design and assembly of the electronic systems to be used for under-Na single-transducer-system is discussed. The amplitude of signals across the piezoelectric plates of an acoustic image-conversion Na-scanner is tabulated. A brief compilation of operation experience from the Fermi Fast Breeder Reactor is given; the design analysis of the FFTF is discussed briefly. (M.L.S.)

35565 (BAW-393-10) THORIUM FUEL CYCLE FOR HEAVY WATER MODERATED ORGANIC COOLED REACTORS. Technical Progress Report No. 7, October 1966-March 1967. (Babcock and Wilcox Co., Lynchburg, Va. Atomic Energy Div.). May 1967. Contract AT(38-1)-393. 18p. Dep. CFSTI.

Work directly relating to the thorium-HWOCR design and development was closed out. Assistance was given to the Evaluated Nuclear Data File Task Force at Brookhaven. This included supplying nuclear data for ^{238}U, ^{232}Th, and lumped fission products. Evaluation work was done on various reactor concepts being considered. (M.C.G.)

35566 (BNWL-SA-1076) DETECTION OF FLAW GROWTH IN PRESSURE PIPING BY SENSING ACOUSTIC EMISSION. Hutton, P. H. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [nd]. Contract AT(45-1)-1830. 11p. (CONF-661211-1). Dep. CFSTI.

From AEC Advisory Committee on Reactor Safeguards, Washington, D. C.

The development of a system for detection of flaw growth in reactor pressure piping by sensing attendant acoustic emission is discussed. A general discussion on methods for measuring this acoustic emission is given. Results from deformation tests, ductility tests, and brittle failure tests are presented. Sensor development is briefly considered. Methods of data analysis are discussed. (M.L.S.)

35567 (BNWL-SA-1102) MEASUREMENT OF NEUTRON FLUX IN FAST REACTOR EXPERIMENTS. Dahl, R. E.; Jackson, J. L. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Mar. 1967. Contract AT(45-1)-1830. 18p. (CONF-670314-6). Dep. CFSTI.

From Liquid Metal Instrumentation and Control Symposium, Idaho Falls, Idaho.

Accurate measurement of neutron flux and determination of spectra are critical in fast reactors for interpretation and application of fuels and materials test data. Relative responses of activation monitors are sufficiently different in fast reactors to require the use of advanced analytical and experimental methods to characterize the nuclear environment. Studies are in progress to develop dosimetry techniques for fast reactor application. Activation monitors are being irradiated in a number of EBR-II positions during normal operation and during low-power physics tests. Data are reduced with spectral-averaged cross sections calculated from detailed transport-theory analyses of the reactor. Correlation between measured and calculated response of the monitors provides a basis for validating the refining calculated spectra and for measuring local perturbations, which are in many instances difficult to calculate. Many irradiation facilities in the EBR-II will be "mapped" during these tests. Measurements made to date indicate that the entire range of neutron energies can be monitored with monitors suitable for extended irradiations. Cross-section uncertainties can be resolved to some extent by the use of several types of monitors to provide greater accuracy. (auth)

35568 (DOCKET-50-249(Vol.1)) DRESDEN NUCLEAR POWER STATION, UNIT 3. PLANT DESIGN AND ANALYSIS REPORT. VOLUME I. (Commonwealth Edison Co., Chicago, Ill.). [1966]. 375p. Dep. CFSTI.

A design and analysis report of the Dresden Nuclear Power Station, Unit 3, is given. Included are: introduction and summary-purpose and scope of report, site and environs, plant design bases dependent on site and environs characteristics, technical description of facility, summary evaluation of plant safety, summary of off-site doses, interactions of units 1, 2 and 3, new plant features, and identification of contractors; principal architectural and engineering criteria for design; identification of major features or components which require further information-development programs and further technical information; reactor design-scope, core nuclear characteristics, fuel mechanical design, core thermal and hydraulic characteristics, reactivity control characteristics, and reactor vessel internal structure; plant safeguards features-scope, reactor primary system, primary containment system, secondary containment other safeguards provisions or systems, structural and shielding design; radioactive waste control systems-scope, liquid radioactive waste control, gaseous radioactive waste control, solid radioactive waste control, radioactive waste control considerations; plant electrical system-transmission system, auxiliary power system, standby diesel generator, station battery; process, area and health monitoring-scope, process radiation monitoring systems, area monitoring systems, personnel monitoring instrumentation, surveillance and testing; other plant features-fuel storage and fuel handling, turbine plant system, reactor auxiliary systems, other plant structures, other service systems; general plant control and instrumentation-general performance requirements, general method of plant control, reactor control, reactor instrumentation systems, reactor protection system, turbine plant control and instrumentation; safety and accident analysis-introduction analysis of accidents, design basis accidents, summary of analytical methods; and plant management. (M.L.S.)

35569 (EUR-3284.d) EXPERIMENTELLE UNTERSUCHUNGEN ZUM FLIESSVERHALTEN EINES KUGELHAUFENS IM HINBLICK AUF DEN BRENNELEMENTKREISLAUF IM CORE EINES KUGELHAUFENREAKTORS. (Experimental Studies on the Flow Behavior of a Pebble Bed with Regard to Fuel Element Circulation in the Core of a Pebble-Bed Reactor). Bedenig, D. (Kernforschungsanlage, Juelich (West Germany)). 1967. 102p. (In German). (THTR-35). Dep.

The pebble-bed flow behavior was experimentally studied with respect to the motion of fuel elements through the core of a pebble-bed reactor. After an introduction on the basic properties of the pebble bed—angle of slope, filling factor, bridge formation, pressure distribution, and arrangement effect—measurement methods for the study of the pebble-bed flow behavior were discussed. Of the two principal possibilities of direct and indirect methods, the indirect methods used in the rotated sphere, the flow-through curve and the spectral methods were discussed. The possibilities for the description of the pebble-bed flow behavior were considered. The theoretical relations used in the description of the flow behavior were given. The continuity conditions for incompressible media used in the representation of the flow tube model were given. A computer program was developed on the basis of this model. With this program the velocity distributions and flow profiles for the pebble bed motion, with knowledge of the pebble-orbit curve and characteristic function, were calculated. The radial velocity distribution, the flow-through curve, and the delay spectrum were introduced as the characteristic functions. The 1:1 graphite pebble model, the steel pebble model, the glass pebble model, and the tuft model were described. Studies were made on the determination of the validity of the flow-tube model. The very good agreement of the experimentally determined results with the results of the computer program show the applicability of the flow-tube model to the calculation of the pebble bed flow behavior. Mass flow distributions and limiting radii for two-zone loading were calculated for various core models on the basis of the flow-tube model. Parameter studies were made on rotation-symmetric core geometries. The effect of the core geometry—

roundness, variation of the output diameter, effect of the cone inclination—and the influence of the pebble-bed properties—friction, relative pebble diameter, and specific weight—were determined. The results were used to estimate the flow behavior in the THTR 300 Mw prototype reactor. For this case, the flow-through curve was given and the velocity distribution in the core, the mass flow distribution, and the limiting radius in the two-zone charging were calculated. The values given were critically evaluated so that error limits were given for the data obtained. (tr-auth)

35570 (EUR-3487.i) L'EFFICACIA DEGLI ASSORBITORI NEL REATTORE DI LATINA. (The Efficiency of the Absorbers in the Latina Reactor). Giannini, G.; Lesnoni, G.; Paoletti Gualandi, M.; Zaffiro, B. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). June 1967. 56p. (In Italian). Dep.

Long-term variations in the reactivity of the Latina Reactor are controlled by altering the weight and number of absorber channels in the core. The measures taken at 1100 and 1500 MWd/t respectively are described. The methods used to analyse the experimental data are discussed. The method of calculating the reactivity controlled by the absorbers and the distributions of interest for purposes of preparing the experimental data, together with the results of a comparison of theoretical and experimental findings is given. (auth)

35571 (EURAEC-1862) DEVELOPMENT PROGRAM ON THE APPLICATION OF STEAM-WATER SPRAY TO REACTOR COOLING: IN-PILE CORROSION OF ZIRCALOY-2 IN STEAM-WATER MIXTURES. Topical Report No. 7. Cerrai, E.; Gadda, F.; Scaroni, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct. 1966. Contract 056.62.1-RDI. 52p. (EUR-3366). Dep. CFSTI.

Work Performed under United States-Euratom Joint Research and Development Program.

The effects of neutron flux on Zircaloy-2 corrosion are measured by in-pile experiments. Results of these tests are presented for given reactor conditions. Effects of temperature on corrosion rate is also shown. Local fast neutron effects are considered. Numerical examples are presented. (M.L.S.)

35572 (EURFNR-312) SOME RESULTS ON THE DEVELOPMENT OF A FAST REACTOR FUEL ELEMENT. Kummerer, K.; Karsten, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Apr. 1967. 24p. (KFK-575; CONF-660502-4). Dep.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

From British Nuclear Energy Society Conference on Fast Breeder Reactors, London.

The fuels development program for fast breeder power reactors is discussed. Results of testing of fabrication techniques, cladding materials, and development of fuel pins are presented; economics of fast breeder fuels is discussed. The irradiation testing of the fuels is detailed. (M.L.S.)

35573 (EURFNR-313) PRODUCTION COST PARAMETER ANALYSIS FOR FAST REACTOR FUEL ELEMENTS. Kummerer, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Apr. 1967. 24p. (CONF-670306-7). Dep.

From IAEA Symposium on Uses of Plutonium as a Reactor Fuel, Brussels, Belgium.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

A production cost analysis is given for fast reactor fuels. A rough approach to cost calculations is presented. Effects of variation of cladding material are discussed. The fabrication costs up to final assemblage are calculated. The effects of variation of fast reactor fuel cycles are discussed. (M.L.S.)

35574 (EURFNR-314) FABRICATION OF FAST REACTOR FUEL PINS FOR TEST IRRADIATIONS. Karsten, G.; Dippel, Th.; Laue, H. J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). Apr. 1967. 16p. (KFK-577). Dep.

Work Performed under United States-Euratom Fast Reactor Exchange Program.

The fabrication of vibratory-compacted UO_2-PuO_2 fuel bearing pins is described under the aspect of test irradiations under the development program of a Fast Breeder Reactor. A design based on theoretical studies and calculation of parameters is needed. A fuel theory is presented, the as-calculated parameters of specific power, diameter, fuel and cladding properties is inserted in formulae, and the maximum available burnup and the density of the fuel pin is found. Then the final design is made. Fuel and cladding selection is done and the materials are tested. Special items of the fuel control are homogeneity of the mechanically mixed UO_2-PuO_2, the Pu-analysis, and the density control. Great efforts have been done on the tubing control. Because of its special problems the vibratory compaction method is described though both it and the pellet line are generally followed in the development program. These special problems are the fuel density, contamination and welding. (auth)

35575 (GA-7010) HTGR BASE PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING FEBRUARY 28, 1966. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). May 15, 1966. Contract AT(04-3)-167. 51p. Dep. CFSTI.

The design and development of a 1000 MW gas-cooled power reactor and a 150-300 MW prototype is presented. The development of analytical methods for elastic stress and creep analysis for prestressed concrete reactor vessels is discussed; the analysis of the PRCV Model No. 1 is presented. The development of shielding and analytical codes is presented. An operations history of the General Atomic In-Pile Loop (GAIL) in GETR is given. Fission product transport and deposition studies are detailed. Reactor physics studies involving two-dimensional multigroup diffusion are discussed; a redesign of the critical experiment for the gas-cooled prototype is given. Recycle studies on high temperature gas-cooled reactor fuels are outlined. Post-irradiation testing of advanced fuels is detailed; results are tabulated. (M.L.S.)

35576 (GAMD-7547) NUCLEAR TRANSIENTS IN REACTORS WITH PACKED BEDS OF COATED PARTICLES. INITIAL STUDIES WITH BLOOST-6. Dahlberg, R. C.; Merrill, M. H. (General Dynamics Corp., San Diego, Calif. General Atomic Div.). Jan. 9, 1967. Contract AT(04-3)-633. 29p. Dep. CFSTI.

The effects of delayed Doppler coefficient on reactivity accidents in high temperature gas cooled reactors is investigated. The effects of separation of fertile and fissile material on transient temperatures were calculated. Homogenization of fuel for the purpose of calculations is evaluated. (M.L.S.)

35577 (KAPL-P-3341) ASYMPTOTIC METHODS FOR SYSTEMS OF DIFFERENTIAL EQUATIONS IN WHICH SOME VARIABLES HAVE VERY SHORT RESPONSE TIMES. MacMillan, D. B. (Knolls Atomic Power Lab., Schenectady, N. Y.). May 17, 1967. Contract W-31-109-eng-52. 6p. (CONF-670624-1). Dep. CFSTI.

From National Meeting of the Society for Industrial and Applied Mathematics, Washington, D. C.

A solution for systems of differential equations, which are applicable to thermal reactor kinetics, is presented. The solution employs asymptotic methods in systems where some variables have very short response times. A numerical application is presented for a point-model thermal reactor having six groups of delayed neutron emitters. (M.L.S.)

35578 (LA-3694) RAPID (REACTOR AND PLANT INTEGRATED DYNAMICS) COMPUTER PROGRAM. Anderson, Carl A. Jr. (Los Alamos Scientific Lab., N. Mex.). Nov. 10, 1966. Contract W-7405-eng-36. 184p. Dep. CFSTI.

RAPID is a digital computer program for the IBM 7094 computer, intended for steady-state and transient analysis of an entire reactor plant. It treats core neutronics and heat transfer in core, reflector, primary loop, secondary loop, heat exchangers, heat dump, and piping and is applicable to a large number of plants, rather than one specific reactor plant. Mathematical and FORTRAN equations are derived and discussed. Capabilities, limitations, and desirable improvements are detailed. (auth)

35579 (NAA-SR-12376) ARIADNE-1: A BURNUP PERTURBATION CODE. Vaughan, E. U.; Berland, R. F. (Atomics International, Canoga Park, Calif.). June 30, 1967. Contract AT-(04-3)-701. 41p. Dep. CFSTI.

Perturbation theory is applied to the problem of calculating fuel depletion in reactors by modifying the perturbation theory used for criticality calculations, as required by the absence of an eigenvalue, and the non-linearity that characterizes the new application. The theory is developed in detail for a simple specific burnup model, and in this form is used as the basis of the burnup perturbation code ARIADNE-I. The effect of the perturbation theory is that, at the cost of approximately doubling the computing time in order to solve the adjoint problem, the code can supplement the usual output of a burnup calculation by giving the derivatives of the burnup lifetime (or time in which depletion proceeds so far that criticality can no longer be maintained) with respect to all the input parameters. The code is written in FORTRAN-IV for the IBM System/360 Model 50, and executes a problem of 150 time steps, including 200 lines of printing, in 25 seconds. Tests of the code confirm the reliability of the derivatives obtained, provided they are not so small that effects of second derivatives become important in the finite dif-

ferences used for the tests. The document includes instructions for using the code, as well as samples of input and output. (auth)

35580 (NAA-SR-12409) SRE-PEP PUMP PERFORMANCE. Peckinpaugh, C. L. (Atomics International, Canoga Park, Calif.). June 6, 1967. Contract AT(04-3)-701. 41p. Dep. CFSTI.

A description is given of the free-surface pumps, similar to those used in the Hallam Nuclear Power Facility, which were installed in the SRE. Preoperational testing, including the pump gas entrainment and oil seal failure, is detailed. Reliability testing and design recommendations are discussed. (M.L.S.)

35581 (NAA-SR-Memo-11485) SODIUM PUMP RELIABILITY DEMONSTRATION. Crown, P. L. (Atomics International, Canoga Park, Calif.). July 1, 1965. Contract AT(04-3)-701. 22p. Dep. CFSTI.

The design, construction and operation of large Na cooled reactors require increased reliability and confidence in the ability of Na pumps to install and operate without excessive development and shakedown time. Experience at HNPF indicates that the development of large sodium pumps is still in the early stages of the development cycle. Operating history is discussed and continued operation, as a means of completing the development cycle and increasing reliability demonstration, is evaluated. (auth)

35582 (NP-16822) RASPREDELENIE NEITRONNOI PLOTNOSTI V RESHCHETKE GETEROGENNOGO REAKTORA VBLIZI SLABOGO VOZMUSHCHENIYA. (Distribution of Neutron Density in the Heterogeneous Reactor Lattice Near a Weak Perturbation). No. 443. Galanin, A. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1966. 26p. (In Russian). Dep.

General formulas describing neutron density distributions within a heterogeneous reactor whose lattice has a weak perturbation (control rod) are derived. These formulas are now applied to the determination of the average neutron density at the surface of blocks close to the control rod located at the center of the cell, of the "skewing" of the neutron density at the surface of blocks close to the control, and of neutron density near the block which differs from other blocks in its properties but is located at one of the lattice points. All theoretical results refer to the control region of a large weakly perturbed heterogeneous reactor and to the case when the internal block effect is sufficiently small. A comparison with known data on heavy water moderated gas-cooled reactors shows a high degree of agreement. (JPRS)

35583 (ORNL-4119) MOLTEN-SALT REACTOR PROGRAM. Semiannual Progress Report for Period Ending February 28, 1967. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 222p. Dep. CFSTI.

Operation of MSRE at 1 Mw began in Jan. 1966. At that power level, plugging of small ports in off-gas control valves occurred. The plugging was largely overcome by the action of filters installed in the off-gas line. The reactor was operated at full design power (7.5 Mw) from May to mid-July when a breakdown occurred in radiator-cooling blowers. While new blowers were being procured, graphite and metal samples from the core were taken and examined. Operation was resumed in October and continued through Jan. 1967 with one shutdown. The reactor performed well in most respects. Other activities during the period are reported on reactor component development, instrument development, materials development, and chemistry research. Results of breeder reactor design studies are also included. (J.R.D.)

35584 (P-3589(RAND)) WHERE IS NUCLEAR REACTOR TECHNOLOGY TAKING US. Gilinsky, Victor (RAND Corp., Santa Monica, Calif.). Apr. 1967. 9p.

The forecast of nuclear technology is discussed. The availability of worldwide U and the by-products of nuclear industry are outlined. After discussing the use of U for power generation, thermal and fast breeder reactors, an estimation of the amount of Pu available is projected. Controls to keep the Pu unavailable for military purposes are discussed. (J.C.W.)

35585 (RT/FI-(67)11) A METHOD FOR STUDYING THE EFFECTS OF PROPAGATION OF THE FINE NEUTRON STRUCTURE IN FAST REACTORS DUE TO THE LIGHT SCATTERING ELEMENTS. Gandini, A.; Salvatores, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1967. 11p. Dep.

A method for making fine structure measurements for analysis of fast reactor experiments is presented. The method is applied to ZPR-9 and ZPR-6 assemblies. Numerical results are presented. Reactivity worths are calculated as a function of change in macroscopic cross section and are presented in tabular form. 10 references. (M.L.S.)

35586 (STI/PUB-21/22) FAST REACTORS. Bibliographical Series No. 22. (International Atomic Energy Agency, Vienna (Austria)). Dec. 1966. 588p. IAEA: $12.00; Australian Schillings 310,-; £4.4.8; F Fr 58,50; DM 48,-.

This bibliography contains 2383 references to the literature in English, French, German, Italian, Japanese, Russian, Spanish and other languages published during the period from September 1958, to May 1966. The reference sources were Nuclear Science Abstracts, Referativnyi Zhurnal - Yademye Reaktory, primary journals, and reports submitted by the Member States to the IAEA. Most references are supplied with abstracts in English. An author index and a subject index are provided. (auth)

35587 (SZS-4/67) BERECHNUNG VON MAXIMAL ZULAESSIGEN KONZENTRATIONEN IN WASSER FUER DIE BEI DER SPALTUNG VON ^{235}U IM REAKTOR ENTSTEHENDEN SPALTPRODUKTE. (Calculation of the Maximum Permissible Concentrations in Water for the Fission Products Arising From the Fission of ^{235}U in Reactors). Strauss, H. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Apr. 1967. 24p. (In German). Dep.

For fission product mixtures produced by thermal fission of ^{235}U in a reactor, the MPC values in water were calculated as a function of reactor operation time and decay time, using a computer. The results are discussed. (auth)

35588 (TID-23868) EFFECTS OF NON-QUIESCENT ATMOSPHERE IN CONTAINMENT VESSELS ON DISPERSION OF FISSION PRODUCTS. Progress Report No. 3. Ozisik, M. Necati; Hughes, Daniel (North Carolina State Univ., Raleigh. Dept. of Mechanical and Aerospace Engineering). Apr. 1967. Contract AT(40-1)-3414. 19p. Dep. CFSTI.

A calculational approach to fission product dispersion in reactor containment vessels is presented. The mass transfer equation is solved assuming an initial uniform distribution of radioactive molecules, total density of the mixture is invariant with respect to both time and position, perfect sink conditions exist at the wall, and the mass transport process is one-dimensional. Both diffusive and convective components are considered in the analysis. The solution to the equation is compared with experimental results from the ORNL Nuclear Safety Pilot Plant. (M.L.S.)

35589 (TRG-REPORT-1374) THE DATA REQUIREMENTS OF THE TRIANGULAR MESH NEUTRON CODES TRIFID AND RAVEN. McCallien, C. W. J. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). Feb. 16, 1967. 32p. Dep. CFSTI, UK 4s.

TRIFID is a FORTRAN IV program which solves the two-dimensional few-group source-sink equations appropriate to a graphite-moderated reactor with a triangular lattice. RAVEN is the name given to a large section of the program which calculates one term in the equations. Both TRIFID and the subsidiary RAVEN can accommodate sufficient mesh points to represent the Windscale AGR and HERO reactors, in three groups, with one mesh point per reactor channel. The program may also be used as a general triangular mesh diffusion code. In addition long-term reactivity calculations for WAGR may be performed. At the start of each time step the irradiations at different points in three dimensions are known and the corresponding values of the cross-sections may be calculated. These are averaged over each channel and the two-dimensional diffusion equations solved. The channel powers can then be found in terms of the fluxes, and finally the changes in irradiation occurring during the time step can be computed. Unirradiated fuel may be loaded, and irradiated fuel may be either unloaded or moved to a new position, between time steps. The principal equations are stated and the data requirements specified in detail. Examples of the data for three kinds of problems are given in an appendix, along with an example of the printed output from the program. (UK)

35590 (UNC-5182) PERFORMANCE EVALUATION OF HEAT EXCHANGERS FOR SODIUM-COOLED REACTORS. Quarterly Technical Progress Report, April 1-June 30, 1967. Israel, S. L.; Nolan, D. J. (United Nuclear Corp., Elmsford, N. Y. Research and Engineering Center). July 20, 1967. Contract AT(11-1)-1452. 55p. Dep. CFSTI.

The evaluation of the thermal-hydraulic and structural performance of heat exchangers for sodium-cooled reactor plants is presented. The evaluation is based on the results of tests of model heat exchangers in the Sodium Components Test Installation (SCTI). An intermediate heat exchanger and a steam generator are the first units to be tested. Modifications were made to the computer programs for evaluating the thermal-hydraulic performance of the steam generator and intermediate heat exchanger. These corrected procedures were used to calculate new "predicted" performance for each of the test conditions. Calculation of tubesheet stresses for a range of ΔT's larger than expected during the tests was started to allow "on-the-spot" estimates during operation. Temperature distributions in the tubesheet regions were re-examined to define the methods used for estimating structural temperatures for the transient tests and to establish procedures for evaluating test performance. Several new references pertinent to tube vibra-

tion were reviewed. A brief study of the stresses in the tack weld of the tubes-to-guide ring in the steam generator indicated that this construction should have infinite fatigue life. However, further review may be necessary after the intermediate heat exchanger tube vibration tests. Calculations were made to compare certain elements of the boiler inlet for the steam generator as rings and as plates with central holes. These indicate that straight ring theory is an unsatisfactory approach. (auth)

35591 (WAPD-TM-687) ANALYSIS OF IN-PILE CREEP MEASUREMENTS OF BULK OXIDE FUELS (LWB-LSBR DEVELOPMENT PROGRAM). Germann, J. D. (Bettis Atomic Power Lab., Pittsburgh, Pa.). May 1967. Contract AT(11-1)-Gen-14. 67p. Dep. CFSTI.

In-pile data for the LWB Project from the KAPL 67-101 ceramic fuel tests have been analyzed using the CYGRO-2 computer program. With the assumption that thermally induced creep was negligible, fission induced creep parameters were determined for the four bulk oxide fuel samples tested. (auth)

35592 (WCAP-2872) VERY LARGE FAST BREEDER REACTOR (VLFBR) SECONDARY SODIUM AND STEAM GENERATING SYSTEM FEASIBILITY STUDY. (Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.). Jan. 1966. Contract W-31-109-eng-38. 168p. Dep. CFSTI.

For Argonne National Lab., Ill.

A description of the conceptual design, estimated cost and development program of the secondary sodium system of the Very Large Fast Breeder Reactor (VLFBR) is given, together with the basis for selection of system parameters, including turbine cycle. The capital cost of the secondary system installed is estimated; the installed cost of the primary sodium pumps is included. Not included is building cost, system engineering, interest during construction and prime contractor's G & A, overhead and profit. It is concluded that 2400 psia and 900°F turbine throttle steam with live steam reheat is a reasonable reference steam cycle for further more detailed studies. (auth)

35593 (EURFNR-267) REPORT OF WORK IN THE 4TH QUARTER OF 1966. Period Covered: September–December 1966. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires. Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Translation of a French report. 89p. Dep.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

Activities at Rapsodie during the period included preloading tests of pumps, valves, handling equipment, control rods and emergency procedures. Operation of the Harmonie reactor, including two shutdowns during the period, is described. Activities at the Masurca reactor during the period were devoted to preparations for startup. Research at Phenix reactor was continued on definition of reference blankets, and on methods of reactor loading in the internal between start-up and core equilibrium. Research and development is also reported on fuel irradiation, sodium cooling circuits, steam generators, shielding, safety, and electric production. (J.R.D.)

35594 NEUTRON BEAMS FROM SPLIT-CORE LIGHT-WATER-MODERATED REACTORS. Downes, Kenneth W.; Court, Anita (Brookhaven National Lab., Upton, N. Y.). Nucl. Appl., 3: 399–405(July 1967). (BNL–10624).

The results of fuel alteration on performance of water-moderated reactors of the Bulk Shielding Facility (BSF) type are given. Thermal neutron beams from split-cores and a standard BSF core were characterized; data were normalized to the standard core. Reactivity characteristics were also investigated. (M.L.S.)

35595 ECONOMICS OF STEADY-STATE ^{233}Pu PRODUCTION IN EPITHERMAL REACTORS. Epel, L. G.; Chernick, J.; Manowitz, B.; Winsche, W. E. (Brookhaven National Lab., Upton, N. Y.). Nucl. Appl., 3: 411-17(July 1967). (BNL–10880).

The availability of U fuels enriched in ^{236}U and ^{237}Np makes it possible to contemplate fuel cycles for the production of ^{239}Pu that operate with equilibrium concentrations of the important nuclides in the production chain. Fuel cycles involving ^{236}U recycle and ^{238}U and ^{237}Np recycle have been studied, and ^{239}Pu production costs have been estimated for two well-developed reactor types. The economic incentives for producing ^{239}Pu in an epithermal reactor are presented, and the estimated production costs are shown to be lower than the generally quoted values. It is also shown that the estimated national requirements for ^{239}Pu can be met with one single-purpose production reactor of moderate size. (auth)

35596 NUCLEAR REACTORS. Kornbichler, Heinz. AEG Mitt., 57: 143-50(1967). (In German).

Besides the description of the growth of the technical areas of nuclear reactors from the beginning to the present, the essential projects and development programs are presented; a short discussion goes into the situation of nuclear techniques at the moment and examines the decisions of the AEG for the boiling water reactor concept. The connection between the General Electric Co., USA, and the AEG is outlined in the area of nuclear technology, through the license agreement. A reference to the future prospects of nuclear energy in Europe and the role of AEG in this fertile future area of energy production is presented. (tr-auth)

35597 NUCLEAR POWER STATIONS. von Horlacher, Hans Heinrich. AEG Mitt., 57: 151-67(1967). (In German).

Emerging from an overall survey of the development of the use of nuclear energy in foreign countries, a treatise is presented of the situation of this field in Germany after the end of World War II. The phase of the official restart of the activity of the German scientists and engineers, after the Federal Republic of Germany, in 1955, acquired its sovereignty, is described. The activities of the AEG in this new field of research and technology are described; further developments of nuclear power station building in the Federal Republic of Germany are discussed. (tr-auth)

35598 ELECTRICAL EQUIPMENT FOR NUCLEAR ENERGY PLANTS. Schruefer, Elmar; Hiesinger, Leopold; Lambacher, Adolf. AEG Mitt., 57: 167-79(1967). (In German).

Production of electricity is the essential function of the nuclear energy installations. The design and marketing of plant components is a task of the corresponding branch of the field division in the nuclear energy installation. Beyond this, the installations emerging over the past years are discussed. Use is made of all measuring and standards instruments, motors, transformers, and generators in the production program. Thereby, useful information can be collected which is then at the disposal of new installations. (tr-auth)

35599 A SINGLE EQUATION OF ORDER m +1 AS A TOOL FOR STUDYING THE m-DELAYED-GROUP POINT REACTOR KINETICS. Ascari, A. (SORIN, Saluggia, Italy). Energ. Nucl. (Milan), 14: 413-18(July 1967).

By eliminating the populations of the delayed neutron emitters from the customary system of m + 1 first-order differential equations of the point reactor kinetics, a single (m + 1)-order equation is derived, which appears to be a promising approach for various applications, including numerical integration. Simple checks of the results are provided by the application to the case of step reactivity input. (auth)

35600 ASSESSMENT AND EXPERIMENTAL INVESTIGATION OF PLUTONIUM POTENTIAL IN ENEL WATER REACTORS. Ariemma, A.; Belelli, U.; Sani, L. (Ente Nazionale per l'Energia Elettrica, Rome). Energ. Nucl. (Milan), 14: 401-12(July 1967).

The phases of the ENEL program are described. These are: feasibility studies of Pu elements for ENEL's water reactors at Garigliano (BWR) and Trino Vercellese (PWR) with an assessment of the economic parameters and related technical aspects; choice of the reactor in which demonstration tests are to be performed by means of an adequate number of pilot elements, and design of the latter; introduction of pilot elements in the reactor to perform a series of experiments and to gather from the irradiation the data required to confirm the design criteria and to check the calculation methods used; final processing of the detailed calculations relating to a Pu fuel cycle, with special attention to the transition stage from the preceding enriched-uranium cycle. (auth)

35601 MEANS FOR INCREASING THE POWER OF THE VVR-S REACTORS. Mihaila, A.; Haraga, C. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 19: 457-60(1967). (In Rumanian).

The methods proposed for increasing the power level of the VVR-S type reactors, to satisfy requirements for a high flux, include: redistribution of the cooling-water flow rate within the core, equalizing the fuel rod temperature distribution; increase of the total water flow, up to the limit of the reserve available in the primary coolant circuit (1200 m^3/hr); and a combination of these methods, raising the level up to 3500 kw. Other methods are based on the utilization of the total interval, up to the temperature of the fuel element that results in the boiling of the water, and increase of the heat-transfer coefficient, by using profiled channels or fuel rods with a roughened surface. The power could be increased by these methods to 4 to 5 Mw. It is also possible to use VVR-M or MR type fuel elements. However, cost considerations make it more attractive to design a new, higher-flux reactor. (TTT)

35602 COOLANT TECHNOLOGY AND FUEL PERFORMANCE IN THE CHEMICAL SHIM PWR. Cohen, P.; Bach, J. H.; Allio, R. J. (Westinghouse Electric Corp., Pittsburgh). Neue Tech., 9: 93-9(June 1967).

Experience in operating pressurized-water reactors is reviewed which demonstrates that UO_2 with either stainless steel or Zircaloy cladding is completely satisfactory for current designs. Examination of several stainless steel clad Yankee fuel assemblies has revealed the appearance and dimensional stability of these elements to be excellent. Similar clad elements have performed with distinction in Saxton. Zircaloy-clad elements have already achieved 36000 MWd/mtU in Shippingport and 18000 MWd/mtU in Saxton; no dimensional instability or effect on corrosion by irradiation in borated systems has been observed. Zircaloy is also serving as the reference cladding for the partial core loading of recycle Pu fuel in Saxton; these fuel elements are expected to reach close to 30000 MWd/mtU at linear power density of almost 20 kW/ft. Thus, the choice of cladding can be made on a purely economic basis. This experience ranges over a wide variety of burnups, enrichments, and power densities and applies equally to "rod only" or chemically-shim-controlled plants. The coolant technology of these reactors is reviewed and related to the fuel performance. A list of 23 references is included. (auth)

35603 FAST REACTOR COOLING PROSPECTS AND DISCUSSION OF ALTERNATE SYSTEMS. Fortescue, P. (General Atomic Div., General Dynamics Corp., San Diego, Calif.); Fischer, P. U.; Shanstrom, R. T. Neue Tech., 9: 100-5(June 1967).

Reasons for considering alternatives to Na for fast reactor cooling are discussed primarily in areas affecting performance, safety, and maintenance. The general nature of techniques in applying gas cooling in this field are outlined with particular reference to criteria by which alternate cooling media should be judged, and the standards to be met for effective performance. Design particularly favorable to gas cooling notably, use of roughened surfaces and selection of appropriate core shape and proper choice of operating conditions, are discussed. The use of steam and He coolants are dealt with more particularly because of general interest in these alternates and because considerably more than heat transfer properties are involved in their assessment. In illustration of the capabilities of gas cooling, reference is made to some results from studies of application in the 1000-MWe power range. (auth)

35604 STUDY SESSION ON THE MANAGEMENT PROBLEMS OF NUCLEAR POWER PLANTS. Born, U. (Eidgenoessische Technische Hochschule, Zurich). Neue Tech., 9: 106-12 (June 1967). (In German).

The experience gained with the fuel of boiling water reactors is discussed. The problems arising due to reactor operation with gross fuel failures are indicated and the reasons for fuel failure are explained. It is shown how the fuel must be burned to avoid dangerous flux peaking at the end of a fuel cycle. Furthermore, the financial advantages of reducing the core size are given, and the application of burnable poison is explained and discussed. (auth)

35605 FUEL SUPPLIES AND FUEL CYCLES OF LIGHT-WATER REACTORS. Schmale, H. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Essen). Neue Tech., 9: 113-26(June 1967). (In German).

The difficulties and the peculiarities attending the supplies and services in connection with the fuel cycle of the pressurized- and boiling-water reactors present the operating companies of nuclear power stations with new tasks and problems which are closely related to the costs of electricity generation. There are good prospects for making the fuel cycle more economical in the future. (auth)

35606 APPROACHING NUCLEAR POWER. Chittenden, W. A.; Nathan, A. (Sargent and Lundy, Chicago). IEEE (Inst. Elec. Electron. Eng.), Spectrum, 4: No. 7, 105-9(July 1967).

Because of economic, system expansion, and air pollution considerations, the committed capacity of nuclear installations in the United States has risen from 3500 MW to approximately 16,000 MW in the past two years. The factors that should be considered in the integration of nuclear energy into a utility system are examined. These include site location and size, scheduling, authorization, public relations, and personnel training. For a typical plant, it is estimated that some 90 man-years are required for personnel training. (auth)

35607 THE USE OF NOETHER'S THEOREM IN REACTOR PHYSICS. Tavel, M. A.; Clancy, B. E.; Pomraning, G. C. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. Nucl. Sci. Eng., 29: 58-66(July 1967). (BNL-10697).

A use of the variational method which has been neglected in reactor theory is discussed. This is the invariance theorem of E. Noether which has been widely utilized in other areas of mathematical physics. Following a derivation of the theorem, its use to obtain solutions of the time-independent diffusion equation is demonstrated. The theorem is used to construct a complete analogy between the time-dependent diffusion process and classical mechanics. Conservation laws arise in the construction of this analogy and their possible application is discussed. An analogy between the neutron diffusion equation and the time-dependent Schroedinger equation is also given. Several suggestions for generalizations of Noether's theorem for use in reactor theory are made. (auth)

35608 STATISTICAL ANALYSIS OF ESTIMATES FOR THE POWER SPECTRAL DENSITY IN NEUTRON MULTIPLYING SYSTEMS. McGrath, E. J.; Albrecht, Robert W. (Univ. of Washington, Seattle). Nucl. Sci. Eng., 29: 67-86(July 1967).

Formal development of the theory for harmonic analysis of neutron multiplying systems is carried out completely in the frequency domain. From basic probability theory, and an assumed reactor model, the problem is expressed as the Fokker–Planck equation in terms of the characteristic function, thus enabling the moments required for a statistical analysis to be obtained. Second-moment calculations include investigation into the bias in estimates of the power spectral density arising from the existence of finite record lengths. It is seen that for even very long records large biases can result, particularly at the lower frequencies. Variance analysis for estimates of the power spectral density investigates all moments up to and including the fourth for neutrons, delayed neutron precursors, and Fourier coefficients. The results show that for the most part, the variances can be described by a single parameter in which the extraneous neutron source plays a particularly important role. For reactors with large sources, the Fourier coefficients are shown to be Gaussian. For systems with small sources, variance in estimates of the power spectral density can become very large, and even the classical smoothed estimate is not consistent. (auth)

35609 PHYSICS OF PERIODICALLY PULSED REACTORS AND BOOSTERS: STEADY-STATE CONDITIONS, POWER PULSE CHARACTERISTICS, AND KINETICS. Larrimore, J. A. (EURATOM, Ispra, Italy). Nucl. Sci. Eng., 29: 87-110(July 1967).

Several aspects of the physics of periodically pulsed reactors and boosters are treated on the basis of the point neutron kinetics model. Steady-state operating conditions are established from delayed-neutron precursor and energy balances. The dependence of the power pulse characteristics and, in particular, the power pulse halfwidth on the principal reactor parameters is derived for both types of systems. Relations for the kinetics of pulsed reactors and boosters are given and the relative sensitivities to reactivity changes are discussed. Design examples are given to illustrate the pulse characteristics achievable in practical systems. Physics design requirements and performance limitations for high-power pulsed reactors and pulsed boosters are mentioned. (auth)

35610 LOOP EXPERIMENT IN ZONES OF NUCLEAR POWER PLANTS. Mathe, I. Gyoergy; Selley, Gabor (Central Inst. of Physical Research, Budapest). Energ. Atomtech., 19: 326-32(July 1966). (In Hungarian).

Static and dynamic models, built within a reactor or another radiation source, play an important role in reactor development, making it possible to observe conveniently radiation-induced changes in the physical, chemical, or technological parameters of the system. The dynamic in-pile loop experiments, usually provided with their own closed-circuit cooling system, represent a pilot-plant scale mock-up of the proposed reactor. The auxiliary equipment, such as circulating pumps and heat exchangers, may be installed within the reactor vessel; the resulting compact design presents fewer radiation protection problems but operation and control is more difficult. Often, only the experimental portion is placed inside of the shield. As that area cannot be entered during operation, the loops must be provided with extensive automatic control and remote handling devices. The design solutions are reviewed on the basis of the coolant used: water, gas, liquid metal, molten salt or organic compounds. The aqueous systems, including pressurized-water, boiling water, steam-cooled, and heavy-water loops, are reviewed in detail. (TTT)

35611 CONDITIONS OF SETTLEMENT OF NUCLEAR POWER PLANTS. Fekete, Laszlone; Hejj, Attila. Energ. Atomtech., 19: 433-40(Sept. 1966). (In Hungarian).

It has been demonstrated that atomic power plants are competitive with fossile-fuel plants. Atomic plants will be used for the direct generation of steam and for remote heating of cities; however, their general acceptance is slowed down by psychological factors, caused by fear-induced exaggeration of the risks involved. Potential reactor accidents must be carefully analyzed, in order to develop reasonable siting criteria. The chief hazard is asso-

ciated with the release of fission products from the reactor fuel; this is prevented by suitable cladding of the fuel elements and provisions for a confinement system around the reactor. Reactor accidents may be caused by unplanned criticality, resulting from runaway conditions, fuel element failure, corrosion of the primary circuit or of the reactor vessel, and contamination of the whole system by experimental devices in the reactor. Supply of conventional fuels and potential future demand of the region, cooling-water supply, closeness to an existing power distribution network, suitability of the ground to support large structures, accessibility and the size of population centers in the downwind direction are criteria considered for proper siting. The importance of geological, meteorological, and population density factors must be jointly evaluated. (TTT)

35612 ANALYTIC STUDY OF THE TRANSIENT BOILING OF SODIUM IN REACTOR COOLANT CHANNELS. MacFarlane, Donald Robert. Lafayette, Ind., Purdue Univ., 1966. 199p.
Thesis.

An analytic model and its use to perform calculations aimed at predicting the time dependent behavior of boiling Na coolant in the channels of a nuclear reactor were studied. Specifically, the information sought is a detailed description of the Na coolant density (vapor void fraction) in space and time during abnormal reactor operation which results in overheating and coolant boiling. Such information is necessary to accurately calculate feedback reactivity effects in transient analyses of large 1000 MW(e) fast breeder reactors. The approach taken in this analysis was to seek solutions for the coupled, non-linear, partial differential equations of fluid dynamics and heat conduction written for a single reactor coolant channel and fuel rod. Mild overpower transients in which the driving function is an exponentially increasing heat generation rate in the fuel and, coastdown of the coolant flow resulting from an exponentially decreasing available pressure head at the coolant channel inlet are studied. These two cases correspond to the inadvertent insertion of reactivity and coolant pump failure situations, respectively. Numerical solutions were obtained for the non-linear forms of the coupled partial differential equations using implicit finite difference equations and an iterative method in an ALGOL computer program. In a typical boiling transient the coolant entered the core hundreds of degrees below its boiling point, was heated to the boiling point in the channel, and exited from the channel with a high vapor void fraction. Results of calculations for a typical fast breeder configuration with UO_2 fuel rods and 50 vol % Na coolant led to the following general conclusions: 1) the rate of coolant expulsion is extremely rapid once boiling starts and is sensitive to the coolant temperature profile in the liquid portion of the channel, 2) the inlet flow decays rapidly to zero, typically by the time 20% of the channel is boiling and, 3) pressure build-up in the channel is not excessively large, typically less than 15 atm. In this analysis sonic effects and critical flow phenomena were not treated, however, the two-phase coolant density is pressure dependent and a temporal and spatial varying liquid/vapor slip velocity is included. (auth)

35613 AN INVESTIGATION OF THE REACTIVITY LIFETIME CHARACTERISTICS OF LARGE COUPLED FAST–THERMAL POWER BREEDER REACTORS. Prabulos, Joseph James Jr. Lafayette, Ind., Purdue Univ., 1966. 327p.
Thesis.

Fast-thermal coupled reactors may operate as power breeders. The variation in reactor physics and engineering parameters with core lifetime (100,000 MWd/tonne) was examined for comparable ^{233}U and ^{239}Pu fueled coupled systems. A cylindrical reference design was used consisting of a 1968 MW(t) fast core with L/D unity and a diameter of 6.19 ft (29.6 vol % oxide fuel, 11.9 vol % SS, 52.3 vol % Na) surrounded by an inner blanket (30.3 vol % oxide fuel, 11.8 vol % Zr, 53.6 vol % Na). Outside the inner blanket is a Be annulus (7.2 vol % Zr, 2.3 vol % Na) surrounded by an outer blanket (53.0 vol % metallic fertile material, 11.2 vol % Zr, 31.9 vol % Na). Fissile volume fractions in the inner blanket are 0.0045 for the ^{233}U system and 0.0030 for the ^{239}Pu reactor. Radial thicknesses of the inner blanket, moderator region and outer blanket are 19.8 cm, 29.8 cm, and 19.8 cm, respectively. The results of the calculations for the various shuffling modes and graded irradiation indicate no significant differences in the parametric variations. One may conclude, therefore, that these methods are not economically feasible for the systems studied which possess uniformly loaded cores. (J.C.W.)

35614 NUCLEAR REACTOR ASSEMBLY. Margen, Peter Heinrich (to Aktiebolaget Atomenergi). British Patent 1,074,345. July 5, 1967. Priority date July 19, 1963, Sweden.

An assembly having a heat exchanger and a pressure vessel containing a nuclear reactor of the pressurized water type using ordinary or heavy water is described. A nuclear reactor and a heat exchanger are joined to form a compact assembly without intermediate pipe connections. (J.C.W.)

35615 TRANSACTIONS OF THE AMERICAN NUCLEAR SOCIETY 1967 ANNUAL MEETING, SAN DIEGO, CALIFORNIA, JULY 23–26, 1967. Trans. Amer. Nucl. Soc., 10: Suppl., 1-38 (June 1967). (CONF-670602).

Titles for summaries of 49 papers presented at the American Nuclear Society meeting on Reactor Operating Experience are listed separately. Topics included are: reactor safety and control; reactor maintenance and component experience; operating experience on research reactors and power reactors; measurement of reactor parameters; fuel and coolant experience; reactor personnel training; and review of Oyster Creek Nuclear Power Station. (D.C.C.)

For abstracts of individual papers see: 35616–35636, 35726–35751, 35767, and 35768.

35616 CHERENKOV COUNTER FOR DETECTING FISSION PRODUCTS IN REACTOR WATER. Herbst, Dale A.; Kuncl, Larry G.; Talboy, James H. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 10: Suppl., 2-3 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35617 FACILITY FOR THE PERFORMANCE EVALUATION OF FULL-SIZE CHARCOAL FILTERS IN REMOVING RADIOIODINE. Miner, Daniel; Fletcher, W. D.; Kitzes, A. S.; Taylor, G. R. (Westinghouse Electric Corp., Pittsburgh). Trans. Amer. Nucl. Soc., 10: Suppl., 1 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35618 EFFECT OF DISSOLVED HELIUM IN SRE. Woodruff, R. W. (Atomics International, Canoga Park, Calif.). Trans. Amer. Nucl. Soc., 10: Suppl., 5-6 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35619 THE STABILITY OF THE ENRICO FERMI REACTOR UNDER AUTOMATIC CONTROL. Klickman, A. E.; Zaman, S. U. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc., 10: Suppl., 6-7 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35620 MAINTENANCE EXPERIENCE: REACTOR RECIRCULATING PUMP. DeWitt, Russell B.; Biggs, Robert R. (Big Rock Point Nuclear Plant, Charlevoix, Mich.). Trans. Amer. Nucl. Soc., 10: Suppl., 9 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35621 LOCATION OF HEAVY-WATER LEAKS IN CANADIAN POWER REACTORS. Dombra, A. H. (Atomic Energy of Canada Ltd., Chalk River). Trans. Amer. Nucl. Soc., 10: Suppl., 10-11 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35622 CALCULATION OF CONCENTRATION TRANSIENTS DURING CHEMICAL DECONTAMINATION OF A NUCLEAR REACTOR PLANT. Beal, S. K.; Henderson, D. R. (Bettis Atomic Power Lab., West Mifflin, Pa.). Trans. Amer. Nucl. Soc., 10: Suppl., 11 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35623 STARTUP OF KERNKRAFTWERK RWE/BAYERNWERK (KRB) NUCLEAR POWER STATION, GUNDREMMINGEN, GERMANY. Brown, G. N.; Burley, E. L.; Christensen, R. W.; Huntley, H. W.; McNelly, M. J. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 10: Suppl., 21 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35624 USE OF AN ON-LINE REACTIVITY COMPUTER TO CALIBRATE CONTROL RODS AT POWER. Long, H. A.; Schlicht, R. W.; Van Howe, K. R.; Weiman, A. L. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Trans. Amer. Nucl. Soc., 10: Suppl., 24 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35625 AT-POWER MEASUREMENTS OF TEMPERATURE COEFFICIENTS OF REACTIVITY. Alligood, F. M. Jr. (Carolinas-Virginia Nuclear Power Association, Parr, S. C.); Willoughby II, W.; Wyke, T. F. Trans. Amer. Nucl. Soc., 10: Suppl., 24-5 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35626 PHYSICS PERFORMANCE OF THE PEACH BOTTOM HTGR. Brown, J. R.; Hopkins, G. R.; Lane, R. K.; Merrill, M. H. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Trans. Amer. Nucl. Soc., 10: Suppl., 26-7 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35627 HEAT TRANSFER IN THE MSRE HEAT EXCHANGER. Piper, H. B. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 29 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35628 APPLICATION OF REACTOR OPERATING DATA TO THE DESIGN AND FUEL MANAGEMENT OF REPLACEMENT FUEL. Sofer, G. (United Nuclear Corp., Elmsford, N. Y.); Buck, P.; Veras, A. Trans. Amer. Nucl. Soc., 10: Suppl., 30-1 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35629 HTGR FUEL-ELEMENT PERFORMANCE IN PEACH BOTTOM REACTOR. Duffield, Robert B.; Turner, Richard F. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Trans. Amer. Nucl. Soc., 10: Suppl., 31 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35630 HELIUM CHEMISTRY EXPERIENCE AT PEACH BOTTOM. Knapp, Walter J. Jr. (Philadelphia Electric Co., Delta, Pa.). Trans. Amer. Nucl. Soc., 10: Suppl., 31 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35631 EBR-II REFUELING EXPERIENCE. Whitham, G. K.; Spalding, T. R. (Argonne National Lab., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 10: Suppl., 32 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35632 FUEL ACCOUNTABILITY EXPERIENCE OF YANKEE ATOMIC ELECTRIC COMPANY. Cordin, Richard A. (Yankee Atomic Electric Co., Boston). Trans. Amer. Nucl. Soc., 10: Suppl., 32 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35633 A STUDY OF THE PROBABILITY OF A FERMI SUB-ASSEMBLY HAVING OVERHEATED BECAUSE OF A MIGRATORY PLUG. Friedland, Aaron J. (Atomic Power Development Associates, Inc., Detroit). Trans. Amer. Nucl. Soc., 10: Suppl., 33-4 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35634 MSRE: TRAINING, PREPARATION FOR OPERATION, AND OPERATING TECHNIQUES. Guymon, R. H. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 35 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35635 NUCLEAR POWER PLANT SIMULATION APPLIED TO REACTOR OPERATOR TRAINING. Ferguson, J. H.; Gridley, R. L; Masche, G. C. (General Electric Co., San Jose, Calif.). Trans. Amer. Nucl. Soc., 10: Suppl., 37 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35636 SHORTCOMINGS OF OPERATOR CREW TRAINING AND INTERNAL CERTIFICATION PROGRAMS. Cramer, E. N. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 37-8 (June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35637 NUCLEAR REACTOR AND PRESSURE VESSEL THEREFOR. Bellaev, Karl Ivan Gunnar (to Aktiebolaget Atomenergi). British Patent 1,075,476. July 12, 1967. Priority date Aug. 22, 1963, Sweden.

A nuclear reactor, cooled and moderated by pressurized fluid, comprises an outer concrete pressure vessel and an inner steel vessel with an intervening space. The dimensions of the latter are so chosen that the pressure of fluid in the inner vessel causes it to expand and contact the outer pressure vessel which is built to withstand any further increase in pressure of the fluid in the inner vessel. Space between the inner and outer vessels is originally created by heating the steel vessel under pressure until the yield point of the steel vessel is exceeded and the vessel has expanded to touch the outer vessel all around. When temperature and pressure are reduced the steel vessel contracts under elastic and thermal deformation leaving a well defined clearance between the two. (P.G.C.)

35638 DEVICE FOR REGULATING THE POWER LEVEL OF A NUCLEAR REACTOR. Costes, Didier; Lebey, Jacques; Martin, Roger (to CEA). British Patent 1,076,708. July 19, 1967. Priority date Oct. 13, 1964, France.

Power level of a nuclear reactor is controlled by raising or lowering a number of neutron absorbing chains. (P.G.C.)

35639 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Barker, Allan (to United Kingdom Atomic Energy Authority). British Patent 1,074,281. July 5, 1967. Filed Feb. 11, 1963.

A fast nuclear reactor comprises a core of fuel elements to sustain a fast fission chain reaction and a feed pump capable of circulating water coolant at a supercritical pressure above 3,206 psia, thereby removing heat from the fuel elements at a rate of at least 8 MW(t) per ft^3 of fueled core. (P.G.C.)

35640 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS. (to General Dynamics Corp.). British Patent 1,076,549. July 19, 1967. Priority date May 5, 1964, United States.

A fuel element for use in high temperature gas-cooled nuclear reactors, operating at high power levels, comprises an elongated body section of refractory material forming annular fuel chambers containing nuclear fuel material and having therein a purge gas passageway and means for connecting the central purge gas passageway to a region of lower pressure than the pressure of the coolant gas. By this design the purge flow carries away gaseous fission products released by the nuclear fuel material. Nuclear fuels specified include ^{233}U, ^{235}U, ^{239}Pu or compounds thereof, or ^{232}Th, or ^{238}U, or compounds, in the forms of granules, granules coated with tar pitch, packets of a mixture of fuel granules and graphite flour, or packets in the form of balls, so designed as to release about 50% of the gaseous fission products formed. (P.G.C.)

35641 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS. (to General Dynamics Corp.). British Patent 1,076,550. July 19, 1967. Priority date May 5, 1964, United States.

A nuclear fuel element suitable for use in high-temperature gas-cooled reactors comprises an extruded graphite body section with radially disposed fuel chambers of wedge-shaped cross-section filled with nuclear fuel. Exemplified is a fuel composed of a solid solution of ThC_2, UC_2, and coal tar pitch formed into a paste. The chambers are filled with the paste under pressure and baked to drive off volatiles. Fuel chambers having non-circular cross-sections are stated to have better heat transfer characteristics than those having circular cross sections. (P.G.C.)

35642 NUCLEAR FUEL ASSEMBLY. Timbs, Arthur Edward; Dodd, John Alan; Prince, Michael John (to Societe Anglo-Belge Vulcain SA). British Patent 1,075,522. July 12, 1967. Filed Feb. 22, 1963.

Nuclear fuel elements are supported in a bundle, with longitudinal axes parallel, by a transverse grid of sinuous metal strips assembled in a hexagonal cell system which is penetrated by the fuel elements and closed by barrel-shaped spacer loops. The mechanism relieves stresses caused by temperature differentials. (P.G.C.)

35643 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. (to Sulzer Brothers Ltd.). British Patent 1,075,361. July 12, 1967. Priority date Sept. 10, 1964, Switzerland.

Power of a nuclear reactor is controlled by rods, containing a neutron absorbing material, arranged to operate in sequence so that at any given time some of the control rods are in one end position while some of the other rods are in the opposite end position and at least one rod and at most two rods are in an intermediate position between the end positions. The design is stated to give a substantially even burnup of the fuel at the ends of the reactor core as contrasted to that of conventional systems. (P.G.C.)

Marine and Portable Power Reactors

35644 (ORNL–4136) TERRESTRIAL LOW-POWER REACTOR PROGRAM. Quarterly Progress Report for Period Ending March 31, 1967. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 38p. Dep. CFSTI.

A survey was conducted to collect information on the size, weight, and cost of several primary power sources. Data are given for diesel generators, batteries, fuel cells, and radioisotope energy sources. Several design precepts are discussed. Reactor design studies of both a 1500-kW(e) boiling-water reactor direct-cycle power plant and a 1500-kW(e) pressurized-water reactor power plant are in progress. Both systems are for land-based applications with heat rejected to air. The designs are

being restricted to meet the requirements of air-transportable packages. The factors leading to the choice of small high-speed turbine-generator units with water-lubricated bearings are discussed. Geometric and performance data are tabulated for 30-, 150-, 500-, and 1500-kW(e) units. A general mathematical approach to the problem of reactor and system control is described. An investigation of the critical sizes, power distributions, and void coefficients of calandria-type boiling-water reactors was begun. The preliminary design of an environmental test facility for low-power isotope power plants is being prepared. The facility will test units designed for both land surface and deep ocean applications. (auth)

Rocket and Space Reactors

Refer also to abstracts 34889 and 35674.

35645 (ANL-7320, pp 186-93) MEASUREMENTS AND ANALYSIS OF Al-, Al_2O_3-, AND BeO-REFLECTED FAST CRITICAL EXPERIMENTS. Butler, D. K.; Doerner, R. C.; Knapp, W. G. (Argonne National Lab., Ill.).

The series of critical assemblies discussed was performed in connection with the program for development of a fast W reactor for nuclear propulsion. A program of critical experiments was planned to obtain some basic information about fast W-based systems. The approach selected was to begin with systems which had already been studied, such as Assemblies 11 and 22 of ZPR-3 and Assembly 1 of ZPR-6. A series of critical configurations was constructed in which only a single change of composition was made from one assembly to the next. The experiments were performed with the split-bed assembly ZPR-9. The cores were made as close approximations to cylinders as possible in the rectangular drawers of the assembly. Criticality was normally achieved by varying the core radius. In each assembly a number of measurements were made. In addition to criticality, determinations of fission-rate distribution, neutron lifetime, and central and spatial reactivity worths were made. Some time was also spent studying properties related to control, including the effect of inserting a ring of B into the reflector near the core boundary. Included are: criticality, the spatial distribution of fission rates, and the worths of various materials at the core center and as a function of radius. (auth)

35646 (N-66-34793) DESIGN GUIDELINES FOR CIRCUITRY IN A NUCLEAR REACTOR-PROPELLED SPACECRAFT. Final Report. Westrom, John L. (Lockheed Missiles and Space Co., Huntsville, Ala.). July 1, 1966. Contract NAS8-11755. 114p. (NASA-CR-77419; LMSC/HREC-A782893). CFSTI.

Radiation resistant circuitry and power supplies are considered in a summary of the guidelines and design efforts for circuitry in a nuclear reactor-propelled spacecraft. Mention is made of the testing of building blocks and circuits, a 200-watt power supply utilizing a switching/summing waveform technique, and the regulator operation. Recommendations for future effort in radiation effects deal with topics such as damaging effects on semiconductors, selective sampling, radiation equivalency, variance of device parameters for transistors, and integrated circuitry. Development of a 400 Hz inverter and its computer mechanization are detailed; including the derivation of equations, block diagrams and circuit illustrations, and performance evaluation. A dc to dc converter is discussed, and an analysis of switching regulation includes details of the derivation of the various equations and the parameters for ideal switching frequency. (auth)

35647 (N-67-19877) FLUID SYSTEMS DESIGN CONCEPT FOR A LARGE GAS-COOLED FISSION-ELECTRIC CELL REACTOR SPACE POWER PLANT. Mokski, D. J. (Jet Propulsion Lab., Pasadena, Calif.). Feb. 1, 1967. Contract NAS7-100. 49p. (NASA-CR-82939; JPL-TM-33-283). CFSTI.

The possibility of using a gas to transport waste heat from a large fission-electric cell reactor directly to a radiator is examined in order to obtain an estimate of: (1) the pumping power that would be required for such a system; (2) the size and weight of the reactor, radiator and other major components; and (3) temperature distributions in the core and other parts of the system. Also, a separate coolant circuit is assumed for removing heat energy from this portion of the core and converting it to electrical power for pumping and auxiliary power by means of a Rankine cycle. The sizes and weights of the major components of the auxiliary power system are also estimated. An overall specific weight of about 6.9 to 13.0 lb/kW(e), not including shields, is obtained depending on the conversion efficiency: the higher weight corresponds to 5% conversion efficiency; the lower, to 10%. As might be expected, the radiator is found to be the largest and heaviest single component. However, the advantage in being able to radiate at a higher temperature is found to result in a potential reduction in radiator area of from 50 to 80% (depending on efficiency) as compared with that required for a comparable plant operating on a thermodynamic power-conversion cycle. (auth)

35648 (NAA-SR-11850) ANALYSIS OF SNAPTRAN-1 AND -2 REACTOR KINETICS EXPERIMENTS. Jackson, J. F.; Rhoades, W. F.; Moss, L. I. (Atomics International, Canoga Park, Calif.). June 26, 1967. Contract AT(04-3)-701. 164p. Dep. CFSTI.

Extensive analyses of the SNAP Transient (SNAPTRAN)-1 nondestructive test series were performed to extract basic kinetics data for a wide range of transient conditions. Detailed analyses of the SNAPTRAN-2 test were also performed to assess the behavior of the SNAP 10A/2-type reactor during a destructive transient. Assessment of the kinetics data was also of principal interest as was the mode of reactor shutdown. A detailed correlation between experiments and analyses was made. (auth)

35649 (NAA-SR-12082) EXPERIMENTAL INVESTIGATION OF THE THERMOCHEMICAL BEHAVIOR OF SNAP FUEL MATERIAL IN A HYPERTHERMAL WIND TUNNEL. Arnold, J. E.; Barsell, A. W. (Atomics International, Canoga Park, Calif.). June 20, 1967. Contract AT(04-3)-701. 159p. Dep. CFSTI.

Experimental support for SNAP fuel element reentry burnup analytical programs and associated fuel particle disintegration studies was provided by a series of ablation tests on actual fuel material in a partially simulated reentry environment. Data were obtained on the transient temperature and hydrogen effusion behavior, surface catalycity effects on heat flux, and ablating particle size distributions and compositions. It was found that good temperature correlation was possible for those test conditions in which nonequilibrium flow effects were small. Fuel surface catalycity effects were found to cause significant heating reductions at conditions where departure from equilibrium flow was effected. For ablating particle size determinations, a laser photographic system proved to be a highly valuable tool. (auth)

35650 (NAA-SR-12382) SNAP REACTOR ABLATION: DISINTEGRATION EXPERIMENT (RADE) IN A HYPERTHERMAL WIND TUNNEL. Arnold, J. E.; Montgomery, L. D. (Atomics International, Canoga Park, Calif.). June 30, 1967. Contract AT(04-3)-701. 132p. Dep. CFSTI.

Experimental support for current SNAP reactor reentry burnup analytical programs was provided by a series of ablation tests on half-scale reactor models exposed to a partially simulated reentry environment. Measurements of the aerodynamic heat flux to the complicated geometry of SNAP reactors were obtained with gold-plated calorimeter models. Data were also obtained on the transient temperature response of the reactor models and on the mode of disintegration of the forward components of the reactor. Application of the measured heat flux data to the analytical method resulted in good correlation of the analytical calculations with the experimental temperature response of the models. These tests failed to demonstrate the mode of fuel element release from the vessel since ablation of the reactor models terminated long before the fuel element bundle was exposed to any great extent. Even though this objective was not satisfied, the results have rendered valuable information to the SNAP reactor reentry burnup program. (auth)

35651 (NAA-SR-12433) EVALUATION OF SNAP REACTOR DISPOSAL TECHNIQUES. Nelson, D. K.; Detterman, R. L. (Atomics International, Canoga Park, Calif.). June 30, 1967. Contract AT(04-3)-701. 76p. Dep. CFSTI.

Active and passive reactor disposal modes have been evaluated to establish their relative merits and conditions of best application for the SNAP reactor. The active disposal modes included deorbit for ocean disposal, intact earth impact and recovery, orbit enhancement, and earth escape. Random reentry was also considered as a disposal mode in the event of active disposal failure and as a primary passive mode. (auth)

35652 (NP-16784) EXPERIMENTAL INVESTIGATION OF FLOW PATTERNS IN RADIAL-OUTFLOW VORTEXES USING A ROTATING-PERIPHERAL-WALL WATER VORTEX TUBE. Travers, Arthur (United Aircraft Corp., East Hartford, Conn. Research Labs.). May 1967. Contract NASw-847. 72p. (F-910091-10).

A water vortex was used to investigate the conditions under which turbulence exists in radial-outflow vortexes with and without superimposed axial flow. The vortex test apparatus used had a 10-in. dia by 30-in. long rotating porous peripheral wall, a 1.0-in. dia rotating inner porous tube located on the centerline, and end walls that could be rotated with the peripheral wall or held stationary. In the tests without superimposed axial flow (basic vortex configuration), plain end walls were used. Flow was injected through the inner porous tube, flowed radially outward, and was withdrawn through the rotating porous peripheral wall. In the tests with superimposed axial flow (axial-flow vortex configuration), one plain end wall and one end wall with a ¾-in.-

wide annulus near its outer edge were used. Flow was withdrawn through the annulus and was injected either through the inner porous tube, through both the inner porous tube and the rotating porous peripheral wall, or through the rotating porous peripheral wall. The characteristics of the flow were determined from observations and micro-flash photographs of dye patterns for different combinations of the flow conditions (values of tangential, radial and axial-flow Reynolds numbers) and the peripheral-wall, inner-porous-tube and end-wall rotation speeds. Tangential velocity profiles were measured for some basic-vortex flow conditions by means of a photographic particle-trace method using small, neutrally buoyant polystyrene spheres. Summary plots indicating criteria for the flow conditions that lead to laminar, alternating laminar and turbulent, and turbulent flow patterns were constructed for both vortex configurations. The results of the tests indicate that radial-outflow vortexes are generally characterized by turbulence with large eddies that convect fluid from the central region of the vortex to near the peripheral wall. These flow patterns exist for both basic and axial-flow vortex configurations and for wide ranges of the flow conditions. Laminar flow was encountered only with low rates of radial outflow and low superimposed axial velocities. Rotation of the end walls had a significant effect on the flow patterns in the basic vortex configuration for a limited range of the flow conditions; rotation of the inner porous tube had no significant effect. Rotation of the inner porous tube and end walls had no significant effect on the flow patterns in the axial-flow vortex configuration. (auth)

35653 (NP-16785) EXPLORATORY FLOW AND CONTAINMENT EXPERIMENTS IN A DIRECTED-WALL-JET VORTEX TUBE WITH RADIAL OUTFLOW AND MODERATE SUPERIMPOSED AXIAL FLOWS. Johnson, Bruce V. (United Aircraft Corp., East Hartford, Conn. Research Labs.). May 1967. Contract NASw-847. 89p. (F-910091-11).

Exploratory fluid mechanics experiments were performed to obtain information applicable to an open-cycle, vortex-stabilized, gaseous-core nuclear rocket. The containment characteristics of confined radial-outflow vortexes with superimposed axial flow were studied to determine whether high average simulated-fuel densities and high ratios of simulated propellant-to-fuel flow rates could be obtained. The experiments concentrated on factors that influence simulated-fuel containment such as simulated-propellant injection methods in which the flow is injected from the peripheral wall of an axial-flow vortex tube with both axial and tangential (circumferential) components of velocity, and simulated-fuel injection methods. The experiments were performed in 10-in.-dia by 30-in.-long vortex tubes. Simulated propellant was injected at the peripheral wall through 600 directed wall jets that could be adjusted to any injection flow angle between the tangential and axial directions. Flow visualization tests were performed using water with dye as a trace fluid. The dye patterns showed that large-scale turbulent mixing occurred between the central region and the peripheral-wall region when the simulated fuel was injected from ducts at the centers of both end walls (radial outflow). Velocity measurements were made using air as the working fluid. These measurements indicated that injection at the peripheral wall with both axial and tangential components of velocity will substantially decrease the average axial velocities in the central region and will create a larger volume within the vortex that is potentially available for containment of fuel. Containment tests to determine the average dwell time of simulated fuel in the vortex tube were performed using a heavy gas to simulate fuel and a light gas to simulate propellant. Compared with the containment times measured with no axial component of injection velocity, improvements in containment time of as much as a factor of three-and-one-half were obtained in this investigation using injection with both axial and tangential components of velocity. The improvements that can be obtained using different fuel injection methods are smaller. However, the maximum containment times that were measured were approximately one to two orders of magnitude less than the value now estimated to be required for an economically practical, open-cycle, gaseous-core nuclear rocket. (auth)

35654 (NP-16786) CONTAINMENT EXPERIMENTS IN VORTEX TUBES WITH RADIAL OUTFLOW AND LARGE SUPERIMPOSED AXIAL FLOWS. Kendall, John S.; Mensing, Arthur E.; Johnson, Bruce V. (United Aircraft Corp., East Hartford, Conn. Research Labs.). May 1967. Contract NASw-847. 92p. (F-910091-12).

An experimental investigation was conducted to determine the heavy-gas containment characteristics of radial-outflow vortexes for potential application to a vortex-stabilized, open-cycle gaseous nuclear rocket engine. Tests were conducted in a constant-temperature vortex with Reynolds numbers based on the superimposed axial flow up to those expected in a full-scale engine. Air was employed to simulate the seeded H_2 propellant and a heavy fluorocarbon was used in most tests to simulate the gaseous nuclear fuel. The effects on heavy-gas containment of changes in the vortex tube length-to-diameter ratio, the light-gas injection geometry and area, the ratio of average heavy-gas density to light-gas density, and the density of the heavy gas at injection were studied. The heavy-gas containment parameters obtained were one to two order of magnitude less than are presently estimated to be required for an economically practical open-cycle engine. The containment parameters varied significantly only with vortex tube length-to-diameter ratio and the ratio of average heavy-gas density to light-gas density. The results of some tests using He injected near the centerline of the vortex indicated that the presence of a light gas in the central region of the vortex has a significant favorable effect on the containment characteristics; these results have potential application to the nuclear light bulb engine. (auth)

35655 (NP-16787) SUMMARY OF GASEOUS NUCLEAR ROCKET FLUID MECHANICS RESEARCH CONDUCTED UNDER CONTRACT NASw-847. Clark, James W.; Kendall, John S.; Johnson, Bruce V.; Mensing, Arthur E.; Travers, Arthur (United Aircraft Corp., East Hartford, Conn. Research Labs.). May 1967. Contract NASw-847. 59p. (F-910091-13).

The characteristics of vortex flows were obtained for evaluating the feasibility of two vortex-stabilized gaseous nuclear rocket engine concepts. Most of the fluid mechanics research was directed toward the vortex-stabilized open-cycle concept, the results are also applicable to the closed-cycle nuclear light bulb concept. Both concepts are based on the transfer of energy by thermal radiation from gaseous nuclear fuel contained in a vortex to seeded hydrogen propellant. In the open-cycle engine, propellant is injected at the peripheral wall of the cavity to drive the vortex and then spirals axially around the fuel-containment region toward the exhaust nozzle. Nuclear fuel is injected into the central region of the cavity where it is contained for a period of time by the vortex flow field. In the nuclear light bulb engine, the propellant and vortex regions are separated by an internally cooled transparent wall. Ne coolant is injected tangent to the inner surface of the transparent wall to drive the vortex and to provide a buffer region to isolate the gaseous nuclear fuel from the transparent wall. Results of the fluid mechanics are investigated and interpreted in terms of the requirements of these two engines. Containment tests were conducted using gases having different molecular weights to simulate the gaseous nuclear fuel and either the propellant or the Ne coolant. Flow visualization tests were conducted and flow-field velocity measurements were made using water and air vortexes to obtain fundamental information on vortex flow patterns. The principal geometrical parameters investigated in the program were the length-to-diameter ratio of the vortex tube, the geometry of the system used to inject light gas at the peripheral wall, the geometry of the system used to inject heavy gas, the locations and sizes of the ports for removing flow (an annulus at the outer edge of one end wall, ports at the centers of the end walls, and ports at the peripheral wall), and end-wall boundary layer control. The flow conditions tested included Reynolds numbers up to those estimated to be required for full-scale engines. Based on the results of this investigation and concurrent engine design and performance studies, it is concluded that the fuel loss rate in a full-scale, vortex-stabilized open-cycle engine would be too great to permit economical engine operation. The maximum containment parameters measured in the two-component-gas tests were more than an order of magnitude less than the value now estimated to be required for the engine. However, certain types of vortex flows that have been investigated appear to be suitable for the nuclear light bulb engine, and it is recommended that further fluid mechanics research be directed toward this concept. (auth)

35656 (NP-16812) PRELIMINARY INVESTIGATIONS TO DETERMINE NUCLEAR-ELECTRIC SPACECRAFT CONFIGURATIONS FOR HIGH-ENERGY MISSIONS. Technical Report 32-1085. Volkoff, J. J.; Womack, J. R. (Jet Propulsion Lab., Pasadena, Calif.). June 15, 1967. 22p.

Related subsystems of two unmanned nuclear electric ion-propelled spacecraft are compared to determine how the mass of spacecraft systems is affected by changes in spacecraft configuration for a conceptual 300-kW(e) nuclear-electric spacecraft designed for a Jupiter orbital mission. The power plant employed a reactor-turbo-generator system. The nuclear-radiation shield, heat-rejection radiators, spacecraft structure, booster-spacecraft adapter, and aerodynamic shroud are considered as subsystems most likely to vary appreciably in mass with changes of spacecraft configuration. The two selected spacecraft configuration concepts feature the heat-rejection radiator systems assembled in the flat-plane configuration and the cylindrical configuration. The flat-plane radiator configuration was found to be the more favorable concept. (auth)

35657 MANIFOLD GASEOUS ROCKET REACTOR. Mills, Carroll B. (Los Alamos Scientific Lab., N. Mex.). Nucl. Appl., 3: 397-8(July 1967). (LA-DC-8702).

A discussion of the manifold gas-to-gas heat-transfer reactor is given. Critical ^{233}U concentration and gas mass are calculated as a function of gas radius for the reactor core. The effective multiplication factor as a function of fuel radius in a cylindrical cavity is given. A comparison of critical ^{235}U fuel concentration is given between core-moderated homogeneous reactors and reflector-moderated reactors. (M.L.S.)

Process Heat and Desalination Reactors

35658 (ORNL-TM-1659) A SURVEY OF OPTIMUM DUAL-PURPOSE DESALTING PLANTS AS A FUNCTION OF PRODUCT RATIO USING ALTERNATE STEAM SUPPLIES. Eissenberg, D. M.; Burwell, C. C. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 290p. Dep. CFSTI.

The results of a computer comparison of the total annual costs of over 1800 dual-purpose plants based on a consistent set of ground rules and cost bases are presented. The design and cost relationships that arise from the coupling of the three components of the dual-purpose plant—energy source, turbogenerator, and distillation plants for the production of large quantities of both electric power and desalted water are examined parametrically. Dual plant cost and design characteristics are determined for a range of values for each of the major parameters of product ratio, water plant size, prime steam cost, capital charge rate, and prime steam conditions. The effect of maximum brine temperature and of off-optimum performance ratio on dual plant annual costs are determined holding most of the parameters constant. A comparison of the value to dual-purpose plants of steam at five different prime steam conditions is included. 12 references. (J.R.D.)

35659 (AEC-tr-6885) ENGLISH TRANSLATIONS OF USSR TECHNICAL PUBLICATIONS ON DESALINATION OF WATER, 1966. Translated from selected reports published by the Central Bureau of Scientific and Technical Information, State Committee for the Utilization of Atomic Energy of the USSR, Moscow. 225p. Dep. CFSTI. JCL $15.00 fs, $6.65 mf.

A collection of 21 technical reports in Russian language concerning various aspects of desalting of water were translated and are presented. (J.R.D.)

35660 WATER DESALTING AND NUCLEAR ENERGY. d'Orival, Michel. Thiemig-Taschenbuecher, Band 16. Munich, Verlag Karl Thiemig KG, 1967. 208p.

Desalting of water for the increased domestic, municipal, industrial, and agricultural requirements in a rapidly increasing populous world is necessary. Distillation, crystallization, solvent extraction, membrane, and ion exchange processes are described and evaluated. Reactors for power generation and coupling to desalting plants are surveyed. A listing of 123 references is included. (J.C.W.)

Research and Test Reactors and Critical Assemblies

Refer also to abstracts 34506, 34507, 34898, 34973, 35384, and 35553.

35661 (AAEC/E-167) CALCULATION OF THE EFFECT OF FUEL PARTICLE SIZE ON REACTOR DYNAMICS. Turner, W. J.; Piper, R. H. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nov. 1966. 18p. Dep.

The effect of fuel particle size on the dynamic behavior of a 500 MW BeO-moderated reactor fuelled with oxide particles of diameter 2 to 500 μ dispersed in BeO is discussed. Negative feedback of reactivity proportional to the reactor power occurs because of the very small thermal time constant of the fuel particles. For large fuel particles the feedback considerably reduces the peak power and the energy release following a reactivity accident. (auth)

35662 (AAEC/E-171) DIFFERENTIAL NEUTRON ENERGY SPECTRUM MEASUREMENTS ON ^{233}U/BeO AND ^{235}U/BeO ASSEMBLIES IN THE REACTOR MOATA. Tattersall, R. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar. 1967. 66p. Dep.

Differential spectrum measurements were made on a series of ^{233}U and ^{235}U fuelled, BeO moderated assemblies with fuel to moderator atomic ratios ranging from 1/6500 to 1/700. A preliminary comparison has been made with calculations of the spectra and, in the thermal region, fair agreement was found for the ^{235}U lattices, but for ^{233}U the experimental thermal flux was significantly higher than that calculated. In the epithermal region above 50 eV, the experimental flux was higher than that calculated for the ^{235}U assemblies, but was in reasonable agreement with calculation for ^{233}U. (auth)

35663 (AAEC/E-177) BUCKLING AND INTEGRAL SPECTRUM MEASUREMENTS IN ^{239}Pu/BeO SUB-CRITICAL ASSEMBLIES. Duerden, P. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). June 1967. 46p. Dep.

The materials buckling of four BeO moderated ^{239}Pu–Al alloy fuelled systems having BeO–^{239}Pu atomic ratios of 1707, 2499, 3749 and 4999 have been measured by the exponential method. Relative fission rates of ^{235}U, ^{238}U and ^{239}Pu were also measured in the equilibrium spectrum region of the same assemblies. Because of the heterogeneous nature of the assemblies, fine structure corrections were applied. Some calculations using the CRAM diffusion code and the GYMEA code are included. (auth)

35664 (AAEC/E-181) WORTH OF BORON ROD IN THE REACTOR MOATA. Spinks, N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). June 1967. 20p. Dep.

The ^{235}U fuel increase required to compensate for the insertion in MOATA of an enriched boron rod is measured. The DIFF code is used to calculate the mass increase and comparison with the experimental result provides a check on the theory incorporated in the code. In addition to the experimental check, a simplified calculational mock-up of the experiment is used as the basis of a more detailed comparison between the diffusion theory and transport theory. The worth of the rod as calculated by the diffusion theory is high by 10% when compared to experiment and low by about 3% when compared to transport theory. In general, the neutron fluxes calculated by the diffusion theory agree to within 2% with those from transport theory. (auth)

35665 (AAEC/M-65(2nd Ed.)) THERMAL NEUTRON FLUX MEASURING EQUIPMENT FOR THE REACTOR HIFAR. Van Heugten, F.; Burnett, I. B. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec. 1966. 18p. Dep.

The equipment for thermal neutron flux measurement in HIFAR is described. Operating instructions are given for parametric measurements with nickel wire and absolute flux determination with gold samples. (auth)

35666 (AECL-2691) CANDU-BLW EXPERIMENTS IN ZED-2. PART III. BUCKLING AND LOSS OF COOLANT EXPERIMENTS. Green, R. E.; Kay, R. E.; Colpitts, C. W. (Atomic Energy of Canada Ltd., Chalk River (Ontario)). May 1967. 44p. Dep. CFSTI. CAN $1.00.

Experiments have been performed in simulated CANDU-BLW lattices in ZED-2 (square arrays of 28-rod UO_2 clusters at a spacing of 27.94 cm) to determine (a) the material buckling of the lattice with H_2O or air as "coolants," and the flux perturbation and reactivity effects of removing the H_2O coolant from 50% of the fuel assemblies in three geometric arrangements. The buckling for the H_2O-cooled lattice was $1.166 \pm 0.018\ m^{-2}$, and for the air-cooled lattice $3.949 \pm 0.039\ m^{-2}$. The loss of coolant experiments indicated a significantly smaller increase in reactivity when alternate fuel assemblies or alternate rows of fuel assemblies were voided than when one-half of the lattice about a dia was voided. (auth)

35667 (ANL-7320) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON FAST CRITICAL EXPERIMENTS AND THEIR ANALYSIS [HELD AT ARGONNE NATIONAL LABORATORY, ILLINOIS], OCTOBER 10–13, 1966. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 818p. (CONF-661019). Dep. CFSTI.

The various phases of fast reactor physics considered in the conference were: differential and group cross sections, tests of cross section sets, clean critical experiments and their analysis, evaluation and computation techniques, Doppler and Na reactivity effects, special experiments and their analysis, spectrum measurements, experimental techniques and equipment, and future programs. A total of 73 papers was presented. Abstracts were prepared for 58 of the papers; 8 papers are included under CONF-661019; abstracts for 6 papers appear in Nuclear Science Abstracts, Vol. 21, under the following abstract numbers 19151, 17520, 19469, 21765, 19468, 5683; one paper is abstracted under the report number TRG-Report-1384. (M.L.S.)

For abstracts of individual papers see: 34464, 35381–35384, 35497, 35546–35563, 35645, and 35668–35700.

35668 (ANL-7320, pp 57-64) INTERCOMPARISON OF CALCULATIONS FOR A DILUTE PLUTONIUM-FUELED FAST CRITICAL ASSEMBLY (ZPR-3 ASSEMBLY 48). Davey, W. G. (Argonne National Lab., Idaho Falls, Idaho).

An international group of establishments which are active in the field of fast reactors was invited to participate in a comparison of the calculated and measured parameters of a Pu-fueled, soft-spectrum, simple-geometry critical assembly to be constructed in Argonne National Laboratory's Zero Power Reactor-3 (ZPR-3). The study of this assembly, No. 48, in the ZPR-3 series, is still in progress. A summary of the available calculated data and the measurements obtained is presented. (auth)

35669 (ANL-7320, pp 66-78) IMPLICATIONS OF RECENT FAST CRITICAL EXPERIMENTS ON BASIC FAST REACTOR DESIGN DATA AND CALCULATIONAL METHODS. Greebler, P.; Gyorey, G. L.; Hutchins, B. A.; Segal, B. M. (General Electric Co., San Jose, Calif.).

Recent experimental information from dilute, Pu-fueled critical assemblies was used to test and to provide guidance for improving fast reactor design data and calculational methods. Most of the experimental data used in this study are taken from ZPR-III Assembly 47 (the SEFOR core mockup). The important nuclear reactor parameters were calculated with a number of variations in nuclear data and calculational techniques. An analysis of the experimental and calculated results shows that by careful adjustment of the important cross sections, a much closer agreement can be achieved between calculations and experiments than that heretofore reported. A complete evaluation was made of the cross-section and resonance parameter data for Pu-239, the most important isotope in this case. The new data yield good agreement with the critical mass of Assembly 47. They result in a calculated Pu-239 Doppler effect that is essentially zero, in agreement with the measured values. A two-dimensional calculation of the neutron lifetime, using group constants that adequately account for the spatial variation of the neutron spectrum, yields a significant improvement over that based on a one-dimensional model. A list of 40 references is included. (auth)

35670 (ANL-7320, pp 80-7) EVALUATION OF BASIC CROSS-SECTION DATA BY ANALYSIS OF FAST CRITICAL ASSEMBLIES. Fillmore, F. L.; Specht, E. R.; Vernon, A. R.; Ottewitte, E. H. (Atomics International, Canoga Park, Calif.).

Calculations of the properties of a number of fast critical assemblies are being carried out as part of a continuing program for testing and evaluating multigroup cross sections for fast calculations. The experiments included in the present analysis have been chosen to cover a wide range of fuel materials and reactor spectra. This increases the ability to identify errors according to the material and energy range in which they occur. The assemblies studied include a number of ^{235}U-fueled ZPR-III assemblies; ZPR-III-45 and 45A, driven Pu assemblies which were mainly used for Doppler measurements; the SEFOR mockup, ZPR-III-47; the Pu-fueled assembly, ZPR-III-48; ZEBRA Core 5; the small fast assemblies POPSY and JEZEBEL (fueled with metallic Pu), and GODIVA (fueled with metallic U). The properties examined include critical mass, Doppler effect, fission ratios, and the reactivity worths of various material replacements. The properties of the small fast assemblies depend only on the high-energy data; they are practically independent of cross sections below 100 keV. However, the larger assemblies require accurate data down to about 100 eV. All of the multigroup cross sections have been constructed using basic microscopic cross-section data and have not been adjusted to force agreement with the critical-assembly data. For the large, soft-spectrum assemblies, the cross sections were weighted by a fine-group spectrum calculated for each assembly. A list of 25 references is included. (auth)

35671 (ANL-7320, pp 107-15) COMPARISON BETWEEN EXPERIMENTAL AND THEORETICAL INTEGRAL DATA ON FAST CRITICAL FACILITIES. CALI, A PROGRAM FOR GENERATING "EFFECTIVE" NUCLEAR GROUP CONSTANTS BY A CORRELATION METHOD. Cecchini, G.; Gandini, A. (Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy). Centro di Studi Nucleari); Dal Bono, I.; Faleschini, B. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo).

In order to treat simultaneously a large number of experimental data relative to a given material, a program (CALI) has been written which determines a new set of "effective" multigroup constants consistent with the experiments considered and as close as possible to a reference set obtained by best-value criteria. Proper allowance is given to the uncertainties of the reference cross sections and to the errors associated with the integral data themselves. This This allowance removes most of the difficulties encountered when correlating data obtained in assemblies with spectral characteristics not sufficiently different from each other with respect to the precision of the experimental techniques. A systematic comparison between experimental and theoretical data relative to the critical facilities ZPR-III, ZPR-VI, and ZEBRA is then performed. The quantities so far considered are the reactivity and fission ratios of Pu-239 and U-233 with respect to U-235. The theoretical predictions are obtained using the APDA 24-energy-group cross-section set and the Russian 26-group one. The new White data of Pu are also considered. The experimental results are corrected for sample size and shape effect. The corrected APDA Pu values and the Russian ones are more consistent with the experimental data than are the uncorrected values of the APDA set, when proper corrections for sample size are introduced. A list of 23 references is included. (auth)

35672 (ANL-7320, pp 116-29) COMPARATIVE STUDIES OF THE CRITICALITY OF FAST CRITICAL ASSEMBLIES. Baker, Arthur R. (Atomic Energy Establishment, Winfrith (England)).

Multigroup calculations of the reproduction factor k for 38 fast critical assemblies built with ZPR-III, Zebra, and Vera are compared. The data sets used are Hansen and Roach; Yiftah, Okrent and Moldauer; Abagyan, Bazazyants, Bondarenko, and Nigolaev; ANL Set 800; FD1 and FD2. A least-squares fit has been made to the computed values of k, assumed to be a linear function of the atomic composition of the core, for each set and the standard deviation of the results significantly reduced. The coefficients of this regression formula give clues to the sources of error in each set and show, among other things, that the success achieved by nearly all sets is partly due to off-setting overreactive ^{235}U and ^{239}Pu data by underreactive ^{238}U data. The regression formula may be used as an interpolation formula to correct the prediction of critical mass for an unknown system. As an example of this use, the critical mass of ZPR-III Assembly 48 is predicted. It is also shown that the standard error of experimental estimates of k for homogeneous spherical cores is 0.003. The paper includes previously unpublished data on the correction necessary to diffusion-theory estimates of k to get transport-theory values in S_4 and S-infinity approximation. A list of 23 references is included. (auth)

35673 (ANL-7320, pp 159-84) EXPERIMENTAL AND THEORETICAL WORK AT THE ZERO-ENERGY FAST REACTOR FRO. Andersson, T. L.; Bjoereus, L.; Hellstrand, E.; Haeggblom, H.; Londen, S-O.; Tiren, L. I. (Aktiebolaget Atomenergi, Studsvik (Sweden)); Kockum, J. (Forsvarets Forskningsanstalt, Stockholm (Sweden)).

The fast reactor FRO is a split-table machine with vertical fuel elements. A quantity of 120 kg ^{235}U is available as fuel, fabricated into metallic plates of 20% enrichment. Of the first five cores studied three (numbers 1, 2, and 4) consisted of undiluted fuel. Core No. 3 was diluted with graphite (29 v/o) and No. 5 with graphite (29%) and polythene (7.5%). All assemblies had a thick reflector of Cu except for No. 4, which had a U reflector. Among the experiments carried out with FRO the following items are dealt with: critical mass, reaction ratios, central reactivity coefficients, and heterogeneity effects. Measurements of reactivity worths of multiplying as well as absorbing control rods are also summarized, including studies of interaction effects and streaming in empty channels. Recently, spectrometry work with proton-recoil counters and Doppler measurements by means of foil activation have been initiated. The latter have been carried out at 590°C, and preliminary results for ^{235}U and ^{238}U have been obtained. The experimental results have been analyzed with various models. The spectrum program SPENG, which includes a data library, has been used to calculate core and reflector fine-structure spectra and to derive multigroup cross-section sets for the different assemblies. For the critical-size and flux calculations the DSN and TDC transport theory programs have generally been employed and a second-order perturbation code has been used to analyze the central reactivity measurements. A list of 41 references is included. (auth)

35674 (ANL-7320, pp 195-203) RECENT FAST CRITICAL EXPERIMENTS IN THE MSCA AND 710-CE. Petersen, G. T.; Kunze, J. F.; Wall, I. B.; Hallam, J. W.; Henderson, W. B.; Warzek, F. G. (General Electric Co., San Jose, Calif. Nuclear Technology Dept.).

The fast core of the Mixed Spectrum Critical Assembly contains a loading of 405 kg $^{235}UO_2$, 1540 kg $^{238}UO_2$, and 1060 kg of Inconel in its 400-liter fast-core matrix. Both calculation and experiment demonstrate that the neutron spectrum in this assembly is spatially asymptotic and representative of a dilute fast ceramic reactor. Recent measurements to be reported in this paper include fission rates of ^{233}U, ^{234}U, ^{235}U, ^{236}U, and ^{237}Np, and neutron lifetime as determined by: pulsed neutron and 1/v poison substitution, and reactivity worths as determined by pile oscillator, and direct period measurements. Work in the 710-CE at the Idaho Test Station has been concentrated on small, hard-spectrum, refractory metal critical experiments related to space power reactor applications. In particular, Be-reflected cores in the 20- to 50-liter range, containing essentially equal volume mixtures of W and fully enriched

U metal and some Ta, have been studied. Some of these assemblies provide necessary design data for compact space reactors, while others are primarily devoted to basic physics measurements and furnish very useful integral data for evaluation of higher-energy cross sections and specialized transport problems. Data reported in this paper are taken from the first basic critical experiment and include: central fission ratios, reflector effects on power distribution and neutron lifetime, and relative reactivity worths. A list of 14 references is included. (auth)

35675 (ANL-7320, pp 205-14) ZPR-3 ASSEMBLY 48: STUDIES OF A DILUTE PLUTONIUM-FUELED ASSEMBLY. Broomfield, A. M.; Amundson, P. I.; Davey, W. G.; Gasidlo, J. M.; Hess, A. L.; Kenney, W. P.; Long, J. K. (Argonne National Lab., Ill.).

A series of relatively simple Pu-fueled assemblies with well-degraded spectra has been designed for study in ZPR-3. Assembly 48, the first in the series, was chosen as the subject of an international comparison of fast reactor calculation techniques. Each assembly in the proposed program will consist of a cylindrical core surrounded by a depleted U blanket. In Assembly 48 the material constituents of the core are limited to Pu, depleted U, Na, graphite, and the stainless steel present in the structure and canning of the Na and Pu plates. Graphite is included to degrade the neutron spectrum. The ratio of U to Pu in the core is 4.2. The program of measurements with Assembly 48 is still in progress. The results of the critical-mass evaluation, fission cross-section ratio, and central perturbation measurements are described. Also included is a brief statement of the results of the neutron spectrum and Doppler coefficient measurements. A list of 11 references is included. (auth)

35676 (ANL-7320, pp 231-6) PHYSICS PARAMETERS OF LARGE DILUTE URANIUM CARBIDE CORES. Rusch, G. K.; Karam, R. A.; Kato, W. Y.; Main, G. W. (Argonne National Lab., Ill.).

Descriptions of the cores, critical masses, sodium-coefficient studies, and radial reactivity worths of core materials of large dilute uranium carbide Assemblies 4Z and 5 in ZPR-6 and Assembly 11 in ZPR-9 are presented. Assemblies 4Z and 11 are zoned core systems. Assembly 5 is a 2600 liter carbide reactor. The cores of all three Assemblies are similar. (M.L.S.)

35677 (ANL-7320, pp 278-97) MONTE CARLO ANALYSIS OF SMALL FAST CRITICAL ASSEMBLIES. Benzi, V.; Cupini, E.; De Matteis, A. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo).

An analysis of several critical fast assemblies containing U or Pu as fuel, and various kinds of materials as reflectors, has been performed by means of an IBM-7094 Monte Carlo code in a multigroup approximation. The main features of the Monte Carlo strategy adopted in this code are briefly summarized. Elastic and inelastic scattering are separately considered, and anisotropy for the elastic scattering has been taken into account. The twenty-group cross-section set adopted for the calculations is given. The multigroup set has been obtained on the basis of microscopic data only, without any a posteriori adjustment. In this way it is hoped that the comparison between the results of calculation and experiments may be useful in setting the limits of confidence both for the method and for the constants adopted, at least for the kind of critical assemblies considered. A list of 10 references is included. (auth)

35678 (ANL-7320, pp 319-33) ZPR-6 DOPPLER MEASUREMENTS AND COMPARISONS WITH THEORY. Till, C. E.; Lewis, R. A.; Hwang, R. N. (Argonne National Lab., Ill.).

The measurements reported were designed to study various aspects of the Doppler effect in a spectrum relevant to a fast power reactor. The method used was based on measuring the reactivity changes resulting from the in-pile heating of small samples in a zero-power assembly. After proof-tests of various kinds, the measurements concentrated on: the ^{235}U Doppler effect as a function of sample size and chemical form; the ^{235}U Doppler effect, with particular attention paid to evaluation of the extraneous effects of thermal expansion; the Doppler effect of mixtures of ^{235}U and ^{238}U; the effect of sodium voiding on the Doppler effect of ^{238}U and ^{235}U. A consistent intercomparison of the most pertinent results, and a comparison of the results with a consistent set of calculations using current theory are presented. A list of 14 references is included. (M.L.S.)

35679 (ANL-7320, pp 345-9) RESULTS OF RECENT DOPPLER EXPERIMENTS IN ZPR-3. Gasidlo, J. M. (Argonne National Lab., Idaho Falls, Idaho).

The results of Doppler experiments in ZPR-3(Idaho) are presented. The experiments were done on two cores: one which served as a SEFOR mockup and the other which was for participation in the international comparison. Reactivity measurements due to change in materials and temperature are presented; Doppler effect measurement results are shown for both assemblies. (M.L.S.)

35680 (ANL-7320, pp 358-67) SOME THEORETICAL STUDIES CONCERNING THE INTERPRETATION OF THE DOPPLER LOOP MEASUREMENTS IN ZEBRA. Codd, J.; Collins, P. J.; Beynon, T. D. (Atomic Energy Establishment, Winfrith (England)).

ZEBRA Core 5 contained an axial heated loop for measuring the Doppler coefficient of fast reactor assemblies mounted at the center of the core. Subsidiary measurements of reactivity worth for a long steel plate held vertically in the loop showed that the correction to the observed temperature coefficients for radial thermal expansion of the loop walls was much greater than anticipated. Analytical studies are described which suggest that the effect could be a consequence of neutron streaming. Numerical calculations using a two-dimensional transport-theory code are in reasonable agreement with the steel-plate measurements in the empty loop, but the agreement is not so good for a case in which an assembly was present in the test zone. Approximate calculations are also made of the Doppler effect of steel in selected test assemblies, as contributed by the 1.15-keV capture resonance in ^{56}Fe. The results imply only a small correction to the large negative Doppler coefficients observed for assemblies containing substantial proportions of ^{238}U. A list of 9 references is included. (auth)

35681 (ANL-7320, pp 369-73) CALCULATION OF THE SODIUM-VOID EFFECT IN LARGE CARBIDE CORES. Heim, F.; Travelli, A. (Argonne National Lab., Ill.).

For safety reasons it is very important to predict the sodium-void effect in the design of large fast power reactors. The sodium-void coefficient was studied in detail with Assemblies 2 and 3 of ZPR-6, which represent in their composition large U-fueled and Na-cooled carbide cores. Measurements were performed in central regions of different sizes and in a large number of off-center regions throughout the cores. Calculations of the Na-void effect and of its individual components were made for the experimental regions by one- and two-dimensional diffusion theory. Perturbation and k-calculations were used in one dimension, while only perturbation calculations were used in two dimensions. The results given by the various calculational techniques are compared to each other and to the experimental values. A list of 9 references is included. (auth)

35682 (ANL-7320, pp 377-85) CALCULATIONAL STUDIES OF SODIUM-VOID REACTIVITY VARIATIONS DUE TO THIN SLAB HETEROGENEITIES IN FAST CRITICAL ASSEMBLIES. Meneghetti, David (Argonne National Lab., Ill.).

Fast critical systems at the Argonne Zero-power Reactors ZPR-III, VI, and IX are constructed of drawers containing plates of various basic materials. The plates are placed in some sequence relative to each other within a drawer. These heterogeneities cause variations of Na-void reactivity values which depend upon the intra-drawer plate configurations. The variations of Na-void reactivity can be interpreted as arising from differences in spatial variations of multigroup fluxes across the drawer-cell, differences in effective resonance self-shielding of the heavy isotopes in the lower energy regions, and in some cases also anisotropic leakage (streaming). The results of calculational analyses generally compare favorably for a series of heterogeneous Na-void experiments reported for ZPR-VI Assembly No. 3. With increasing thickness of unseparated Na plate-regions there resulted perceptibly less-negative calculated values than experimentally reported. The difference is attributed to anisotropic leakage. Results are also given of calculations of the excess reactivity of the heterogeneous ZPR-VI Assembly No. 3 system relative to a homogeneous system. A list of 16 references is included. (auth)

35683 (ANL-7320, pp 386-92) A PRELIMINARY INVESTIGATION OF THE EFFECT OF HETEROGENEITY ON ACTIVATION DOPPLER EXPERIMENTS. Nicholson, Richard B. (Argonne National Lab., Idaho Falls, Idaho).

A method has been developed for approximate calculation of the Doppler coefficient of activation in small-sample experiments when the experimental environment consists of a heterogeneous arrangement of plates. The activation is calculated in cylindrical geometry on the axis. The surrounding material is divided into any number of (Δr, $\Delta\varphi$) zones with uniform composition within the zone. The activation is given by

$$A(T_c,T_s) = \sum_{i,g} \frac{S_i^g \Delta\varphi_i}{2\pi} \int_0^{} \frac{dE\ \sigma_\gamma(E,T_s)}{\Sigma_{ti}(E,T_c)} \cdot \{Ki_3[P_i(E,T_c)] - Ki_3[P_i'(E,T_c)]\}$$

where i stands for a zone; g for an energy group; T_c is the core temperature; T_s the sample temperature; S_i^g the smoothed neutron source in zone i and group g; $\Delta\varphi_i$ the angular width of zone i; σ_γ the activation cross section; P_i the optical path from the axis

to the inner radius of zone i; and P_i the optical path to the outer radius of zone i. The function $Ki_2(P)$ is

$$Ki_2(P) = \int_1^\infty \frac{dx \exp(-Px)}{x^2\sqrt{x^2-1}}$$

Preliminary analysis indicates that it is very difficult to attain a flux spectrum at the sample characteristic of a homogeneous medium with the plate thicknesses normally available in critical assemblies. It is further shown that if one wishes to attain the best approach to homogeneity, the plates should be oriented so that the sample views them broadside rather than end on. Some rough guidelines have been established for selecting the best plate arrangement. (auth)

35684 (ANL-7320, pp 403-20) EXPERIMENTAL VERIFICATION OF REACTOR PHYSICS PARAMETERS OF ZONED CORES. Karam, R. A.; Ancarani, A.; Helm, F.; Kato, W. Y.; Main, G. W.; Rusch, G. K. (Argonne National Lab., Ill.).

Results from three different assemblies, two zoned cores and one full-size core, are discussed. These cores are separate assemblies of ZPR-6 and ZPR-9. Neutron fluxes and adjoints are tabulated for center and 30 cm from center of the various assemblies. Axial fission ratios are tabulated as a function of distance; radial fission ratios are given relative to core centerline. A radial traverse of the ^{235}U fission rate is shown for ZPR-6; the ^{238}U fission rate is given as a function of radius. Axial traverses for ^{235}U and ^{238}U fission rates are shown graphically for ZPR-6. Central reactivity worths for ZPR-6 and ZPR-9 assemblies are tabulated. A list of 15 references is included. (M.L.S.)

35685 (ANL-7320, pp 448-55) A P_N APPROXIMATION USING INTEGRAL TRANSFORMS AND ITS APPLICATION TO CONTROL-ROD CALCULATIONS FOR THE ZERO-ENERGY FAST REACTOR FRO. Haeggblom, Hans (Aktiebolaget Atomenergi, Stockholm (Sweden)).

A new method for the solution of the P_N equations is described. The conventional P_N equations in spherical geometry are transformed to coupled integral equations. Hereby, a "spherical" Hankel transform is used, i.e., the transformation kernel is a spherical Bessel function. This can be interpreted as an expansion of the flux into a continuous spectrum, where the new independent variable is the buckling. No inner boundary conditions are required, and the outer boundary conditions are fulfilled by assuming a surrounding medium having only the capture cross section different from zero. The equations are solved numerically by Lanczos' method. A program, HATTEN, has been developed which solves the equations in P_3 approximation for two media. Criticality calculations in 1, 3, and 6 energy groups have been compared to corresponding solutions in diffusion and S_4 approximations. The P_3 and S_4 calculations for a reflected system give comparable accuracy in critical mass, and the fluxes are nearly identical except at the outer boundary. The computation times are of the same order. There is no sharp peak in the flux amplitude as a function of buckling, not even for bare systems. It is also possible to calculate higher eigenvalues, and it is shown that the first eigenvalues are very close together. The scalar flux together with the Legendre moments are used in perturbation-theory calculations to obtain the reactivity of control rods. Thus, the streaming effect is included in the calculation. The reactivity is obtained as a function of the axial and radial position of the control rod in a spherical system. (auth)

35686 (ANL-7320, pp 477-80) SPECTRUM MEASUREMENTS IN A LARGE DILUTE PLUTONIUM-FUELED FAST REACTOR. Bennett, E. F.; Gold, R.; Huber, R. J. (Argonne National Lab., Ill.).

Spectrum measurements have been made at the center of the ZPR-3 Assembly 48, a large, dilute, Pu-fueled fast reactor. The energy distribution of fragments from the $^6Li(n,\alpha)t$ reaction and of protons recoiling in a H proportional counter can be interpreted in terms of the neutron-energy spectrum. The results of measurements with the two techniques are compared, and the agreement is within estimated errors. (auth)

35687 (ANL-7320, pp 481-5) A COMMENT ON THE COMPARISON OF THEORETICAL WITH EXPERIMENTAL NEUTRON SPECTRA IN FAST CRITICAL ASSEMBLIES. Travelli, A. (Argonne National Lab., Ill.).

The experimental data obtained by Bennett in the measurement of central neutron spectra in fast critical assemblies have a resolution of 15 to 20% in energy over the energy range, which extends approximately from 1 keV to 1 MeV. The high resolution, combined with the small statistical error of the data, makes it possible to measure, in addition to the macroscopic behavior of the neutron spectrum, some of the microscopic variations of the spectrum at those energies for which resonances of the light elements cause sharp variations of the transport cross section. The greater resolution of the experimental spectra raises the question as to how accurately the present analytical methods can predict the microscopic variations of the spectrum, and adds considerable interest to the comparison of experiment with theory. The results of two such comparisons are shown in which some detailed experimental spectra were matched to corresponding high-resolution calculations. A list of 14 references is included. (auth)

35688 (ANL-7320, pp 486-9) COMMENT ON SPECTRUM MEASUREMENTS IN A LARGE, DILUTE PLUTONIUM-FUELED FAST REACTOR. Brown, P. S. (General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.).

A generalized description of a proton-recoil spectrometer for neutron spectrum measurements is given. Experiments utilizing this spectrometer are briefly discussed. Comparisons of the spectrum at core center of ZPR-3 and in the blanket of ZPR-3 are shown graphically. (M.L.S.)

35689 (ANL-7320, pp 501-5) A COMPARISON OF MEASURED AND CALCULATED ENERGY SPECTRA IN TWO VERA CORES. Weale, J. W.; Benjamin, P. W.; Paterson, W. J. (Atomic Weapons Research Establishment, Aldermaston (England)).

Spectra have been measured over the whole energy range in two VERA fast reactor assemblies, designated VERA 16Z5A and VERA 17Z5J. In particular, the low-energy spectra have been determined by the time-of-flight technique, and this has been checked in one of the assemblies against a proportional counter using pulse-shape discrimination. The measured spectra are compared with spectra calculated by means of the FD1 and FD2 data sets, and these are shown to be in error in predicting too low a neutron flux in the low-energy range. The experimental assemblies are similar to two ZEBRA assemblies in which the Doppler temperature coefficient has been measured. (auth)

35690 (ANL-7320, pp 506-22) MEASUREMENTS OF NEUTRON SPECTRA AND DECAY CONSTANTS WITH THE FAST SUBCRITICAL FACILITY SUAK. Kuechle, M.; Mitzel, F.; Wattecamps, E.; Werle, H. (Kernforschungszentrum, Karlsruhe (West Germany)).

SUAK is a small, unreflected fast subcritical facility fuelled with thin plates of 20% enriched U metal. With a 200-keV, pulsed neutron generator, measurements of the prompt-neutron decay constant and of the neutron spectrum were performed. The first assembly consisted of pure U only; then different amounts of polyethylene were added to shift the neutron spectrum. The neutron spectra at the center and at the surface of the pure U assembly have been measured by the time-of-flight method and with a series of spherical proton-recoil proportional counters. The experimental results were compared with calculations in which different approximations and cross sections were used. The experimental neutron lifetime was always longer than the calculated one. The deviation amounts to only 4% for the pure U assembly and to about 30% for the H-moderated assemblies. Situations with good time-eigenvalues, with quasi-modes and where no exponential could be found, were observed in the SUAK assemblies in agreement with theoretical predictions. Different types of pulsed reactivity determinations were used. In addition, a modulated source technique was tried for the determination of $(1 - k_{eff})/l$. In connection with the measurement of the spectra by the time-of-flight method the problems of background, detector efficiency, and resolution correction are discussed. The calibration and the evaluation procedure of data obtained with the proton-recoil detector are described. A list of 18 references is included. (auth)

35691 (ANL-7320, pp 535-9) MEASUREMENT OF EPITHERMAL SPECTRA IN FAST ASSEMBLIES USING RESONANCE SANDWICH DETECTORS. Weitzberg, Abraham (General Electric Co., Pleasanton, Calif. Vallecitos Atomic Lab.).

Resonance detectors, in general, are not suited for spectrum measurements in fast assemblies because of the contributions of 1/v captures and captures in resonances of higher energy. The sandwich-foil technique can be used to eliminate, for the most part, these interfering activities. Sandwich-foil measurements were made in the fast core of the Mixed Spectrum Critical Assembly (MSCA) and in the ZPR-3 Assembly 48. The detector foil sandwiches had been previously calibrated in a known 1/E spectrum. The results reported are of a preliminary nature only. They show that the sandwich-foil technique does provide a measure of the fast-reactor spectra below 3 keV. However, the present state of the art only gives a qualitative picture of the spectrum. (auth)

35692 (ANL-7320, pp 543-8) UTILIZATION OF FAST CRITICAL ASSEMBLIES FOR FAST REACTOR DESIGN. Loewenstein, W. B. (Argonne National Lab., Ill.).

The role of the fast critical assembly for fast reactor design

is reviewed primarily on the basis of past experience and projected ultimate application. Certain integral data which have not received much recent experimental emphasis but are important to confident reactor design are described. It is judged that engineering-mockup-related critical experiments will be needed for some time, at least until analytical methods and differential nuclear data may be confidently used for conventional fast reactor design. It is, however, necessary to project the development of relatively clean critical experiment data beyond the time when engineering mockups will be required for reactor design. Such problem oriented experiments will continue to give insight on more confident fast reactor design by narrowing the gaps between predicted and observed high-power LMFBR performance. A list of 10 references is included. (auth)

35693 (ANL–7320, pp 550-9) THE CRITICAL EXPERIMENTS AND PRELIMINARY ANALYSIS OF MULTIFUELED, NONUNIFORM CORE LOADINGS FOR THE FARET PROGRAM. Persiani, P. J.; Hess, A. L.; Kucera, D. (Argonne National Lab., Ill.).

A series of small, Pu-plus-U-235-fueled fast reactor cores with steel radial and axial reflectors were constructed in Argonne's Zero Power Reactor-3 as part of the design program for the FARET reactor. These studies, designated ZPR-3 Assembly 46, were essentially mockups of possible loadings of the FARET core. The primary objective of the studies was to confirm the physics analysis of multifueled, nonuniform core loadings as were envisaged for the FARET system. A principal interest in the studies was to establish experimentally the predicted reactivity control afforded by the control-rod designs for FARET. The agreement obtained between calculations and the results of experiments for control-rod worth was sufficient to establish the range of control possible in the FARET reactor. Of equal importance was the substantiation of the neutronic behavior of a mixed core in FARET when subassemblies of different types of fuels were interchanged. Analytical calculations were done for all experiments, and the methods for analysis that were adopted are discussed. (auth)

35694 (ANL–7320, pp 560-8) CRITICAL ASSEMBLY MOCKUP OF THE SEFOR REACTOR IN ZPR-3. McVean, R. L.; Goin, R. W.; Weitzberg, A.; Leridon, A.; Kremser, J. (Argonne National Lab., Idaho Falls, Idaho).

The critical assembly for the SEFOR reactor, which has been built in ZPR-3, is the first large, Pu-fueled critical assembly to be built in the fast breeder program. Beryllium oxide has been included in the design of the 528-liter core to soften the neutron spectrum to match more nearly that of a large power reactor and to enhance the Doppler effect. Metal fuel plates are used in the core. Sodium carbonate, along with some Al is used to represent the Na coolant and the O in the SEFOR oxide fuel. There is a region of Na and stainless steel between the core and the radial reflector. The reflector is made of Ni and is used for control of the SEFOR reactor. (auth)

35695 (ANL–7320, pp 569-84) APPLICATION OF THE SEFOR CRITICAL EXPERIMENTS AT ZPR-3 TO SEFOR. Reynolds, A. B.; Stewart, S. L. (General Electric Co., San Jose, Calif. Advanced Products Operation).

A series of critical experiments was performed with a mockup of SEFOR at ZPR-3. Analyses of these experiments and the application of the results to the SEFOR design are discussed. Values of the critical mass were determined for 1-, 2-, and 3-segment SEFOR fuel designs in order to help establish the Pu atom fraction in the SEFOR fuel. Reactivity effects of axial fuel expansion were measured which led to selection of the 2-segment design for SEFOR. Measurements of the reactivity worth of the radial reflector established the adequacy of the SEFOR reflector-control system. The Doppler coefficient was measured. The calculated ^{238}U Doppler coefficient was in agreement with the experimental value; the measured ^{239}Pu contribution to the SEFOR Doppler coefficient was near zero. The maximum positive reactivity due to loss of sodium was measured. The ratio of prompt-neutron lifetime to delayed-neutron fraction was measured both by the pulsed neutron technique and by noise analysis. The values measured by the two techniques were in agreement. Fission ratios, fission and boron traverses, and plutonium worth distributions were measured and compared with calculations. A list of 17 references is included. (auth)

35696 (ANL–7320, pp 657-62) SOME RECENT EXPERIMENTAL TECHNIQUES DEVELOPED IN IDAHO DIVISION OF ARGONNE NATIONAL LABORATORY. Davey, W. G.; Amundson, P. I.; Keeney, W. P.; Gasidlo, J. M. (Argonne National Lab., Idaho Falls, Idaho).

The improvement of existing experimental techniques and the development of new methods have been undertaken with the principal aim of understanding the physics of large, dilute, Pu-fueled fast reactors. The techniques described are improvement of fission-ratio measurements, an activation method for measuring the ^{238}U capture cross section, a measurement of the change in activation of a thin ^{238}U foil due to the Doppler effect, the measurement of the ^{10}B (n,α) and He (n,p) cross sections relative to the fission cross section of ^{235}U, the measurement of the Mn and Na capture cross sections relative to the fission cross section of ^{235}U, and measurements of the effect of inelastic scattering in shells of reactor materials. (auth)

35697 (ANL–7320, pp 679-87) AN INTERNATIONAL COMPARISON OF FISSION DETECTOR STANDARDS. Amundson, P. I.; Broomfield, A. M.; Davey, W. G. (Argonne National Lab., Idaho Falls, Idaho); Stevenson, J. M. (Atomic Energy Establishment, Winfrith (England)).

Parallel-plate fission chambers presently in use in Idaho Division of Argonne National Laboratory for measurements of fission ratios have been compared with selected chambers from the Zebra reactor group at Winfrith, the fast reactor group at Cadarache, and the critical experiments group at Los Alamos. An attempt has been made to tie these measurements in with foils used for measurements of differential cross sections at Los Alamos and Aldermaston. At present, comparisons with Winfrith have been made using ^{235}U, ^{233}U, and ^{239}Pu chambers. Measurements were made both in the Zebra reactor at Winfrith and in Idaho Division's Fast Source Reactor. Comparisons of Winfrith ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu chambers with similar chambers used in the Vera reactor at Aldermaston have been made in Zebra. The comparison with Cadarache has been limited to a direct ^{235}U chamber comparison. A French re-appraisal of calibration techniques resulted in a quoted mass only a few percent different from that estimated from a comparison with the Idaho Division and Winfrith chambers. The comparison with Los Alamos values involves fission-ratio comparisons in the Flattop reactor and a ^{235}U thermal comparison in the thermal column of the Water Boiler reactor with standards used by various groups measuring differential cross sections. A list of 9 references is included. (auth)

35698 (ANL–7320, pp 694-704) PULSED-SOURCE, ROSSI-α AND VARIANCE-TO-MEAN MEASUREMENTS PERFORMED AT THE FRO REACTOR. Bergstroem, A.; Brunfelter, B.; Kockum, J.; Soederberg, S. (Forsvarets Forskningsanstalt, Stockholm (Sweden)).

Pulsed-source and Ross-α measurements have been performed with three different FRO assemblies, two with Cu and one with natural U reflectors. The results have been compared with calculations made with a time-dependent S_N code and with applications of a point-reactor and a two-region model. The experiments and calculations show that the time necessary to reach equilibrium in the low-energy part of the neutron spectrum is comparable to the total decay time of the neutron pulse when the reflector consists of light material with low absorption. The possibility of using the pulsed-source technique for reactivity determinations in this type of reactors has been demonstrated. β_{eff} separated from other neutron parameters has been measured in one assembly using the variance-to-mean method and an absolute efficiency calibration of a ^{3}He gas scintillator. The accuracy obtained is about 7%. Means of improving this to about 3% are given. The measured value agrees with theory within the uncertainties. A list of 17 references is included. (auth)

35699 (ANL–7320, pp 706-13) PRECISION PULSED MEASUREMENTS WITH REFLECTED FAST CRITICAL ASSEMBLIES. Brunson, G. S.; Huber, R. J. (Argonne National Lab., Idaho Falls, Idaho).

Pulsed neutron-die-away experiments were performed with three fast critical assemblies having reflectors of relatively low-density material. In all three cases the descriptions of the neutron-die-away curves required two exponentials plus a background term. The data were analyzed in terms of a simple two-region model which considers delayed neutrons as part of the background. The equations were solved by transfer-function techniques. By this analysis it was possible to assign a prompt-neutron lifetime to core neutrons and to the system as a whole. Further, the model used predicts that the die-away curves in the reflector will contain two exponential terms having the same two exponential decay constants as were found in the core, and that the coefficients of the faster will be negative. This was found to be the case. A list of 14 references is included. (auth)

35700 (ANL–7320, pp 776-84) THE JAERI FAST CRITICAL FACILITY. Hirota, J.; Nomoto, S.; Nakamura, T.; Iijima, T.; Hiraoka, T.; Hirakawa, N. (Japan Atomic Energy Research Inst., Tokyo).

The fast critical facility, called the "FCA," is now almost completed at the Japan Atomic Energy Research Institute. The main

features of the facility and the experiment program are presented. The reactor is the split-table type of horizontal matrix structure. The matrix consists of 35 rows by 35 columns, but it is designed so as to be easily extended to 51 rows by 51 columns in which large cores up to 3000 liters with a 50-cm-thick blanket can be built. The facility is provided with a pulsed neutron source of 200-keV, Cockcroft–Walton type of accelerator which generates neutron bursts from 0.05- to 10-μsec width at the center of the assembly. The facility will go critical in the spring of 1967, with 20% enriched U. The experimental program will be mainly concerned with the Na-void and the Doppler effects in large fast reactors. Accordingly, the heterogeneity effect in the Na-void experiment is now being theoretically studied. Regarding the Doppler experiment, an intermediate-energy system suitably moderated in order to enhance the Doppler effect is proposed. (auth)

35701 (BNL–50023) NUCLEAR ENGINEERING DEPARTMENT ANNUAL REPORT, DECEMBER 31, 1966. (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. 191p. Dep. CFSTI.

Results of basic research on the fundamentals of reactor physics, chemistry, and metallurgy are reported. Progress is reported in long-range studies aimed at effecting advances in reactor technology and radiation applications. Engineering and evaluation studies focused on practical application of developments resulting from research are summarized. Research and development on settled bed fast reactors are outlined. Work by the reactor physics division, chemistry and chemical engineering division, radiation division, hot laboratory division, metallurgy and materials science division, and engineering division is outlined. (J.R.D.

35702 (BNWL-CC–1205) PRELIMINARY CALCULATIONS FOR H_2O-MODERATED LATTICES OF UO_2–4 WT. PERCENT PuO_2 FUEL RODS. Kobayashi, S.; Uotinen, V. O. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 17, 1967. Contract AT(45-1)-1830. 32p. Dep. CFSTI.

Physics calculations, preliminary to experiments, for determining cell-averaged lattice constants are presented. Calculations were made for 7.65 wt % and 23.5 wt % ^{240}Pu lattices for three geometries. All parameters are tabulated. Cell-averaged macroscopic cross sections are shown as a function of lattice spacing. Numerical descriptions are given for each of the ^{240}Pu cores. The calculated thermal neutron energy spectrum is shown. (M.L.S.)

35703 (BNWL-SA–769) MEASUREMENTS OF NEUTRON MULTIPLICATION FACTOR FOR A PuAl–THORIA SUPERCELL. Hill, N. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). [1965]. Contract AT(45-1)-1830. 23p. (CONF-661001–49). Dep. CFSTI.

From 14th Conference on Remote Systems and Technology, Pittsburgh.

Values of the infinite medium neutron multiplication factor, k_∞, have been determined for a mixed lattice in the Physical Constants Testing Reactor (PCTR). The lattice contained graphite moderator with PuAl fuel and thoria target in alternating cells and was water cooled. Determinations of k_∞ were made with the coolant channels wet and dry to obtain an estimate of the reactivity coefficient due to water loss. (auth)

35704 (BNWL-SA–1332) EVALUATING CONTROL AND DATA HANDLING INSTRUMENTATION FOR THE FAST FLUX TEST FACILITY (FFTF). Markillie, William R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). July 12, 1967. Contract AT(45-1)-1830. 21p. (CONF-670903–7). Dep. CFSTI.

From 22nd Instrument-Automation Conference and Exhibit, Chicago, Ill.

The Fast Flux Test Facility (FFTF), a fast neutron, liquid-metal-cooled test reactor, requires sophisticated controls over all process and test conditions to assure reactor safety, test data validity and plant availability. A figure of merit model was developed to evaluate several process control and data handling instrumentation concepts qualitatively and quantitatively. The model includes these features of process control and data handling instrumentation: safety; operating continuity; data handling; control quality; human factors and flexibility. The results of the evaluations of four instrumentation concepts were compared to determine the concept of greatest worth. Those comparisons indicated that the concept of greatest worth is one that consists of a redundant arrangement of digital computers for handling all process and experiment data, for control of much of the process and experiment equipment, and for operating alarm and display equipment. Those figure of merit results together with the cost estimates for the instrumentation concepts and other considerations will be used to make the concept selection. (auth)

35705 (BRL–MR–1841) NEUTRON SPECTRAL MEASUREMENTS BY MAGNETIC ANALYSIS OF RECOIL PROTONS. Cialella, C. M.; Connor, J. M.; Hoffman, C. W. (Ballistic Research Labs., Aberdeen Proving Ground, Md.). May 1967. 40p. CFSTI.

The spectral distribution of neutrons from the TRIGA Mark F Reactor at the U. S. Army Harry Diamond Laboratories was measured with a magnetic neutron spectrometer. This instrument is a broad range, low deflection spectrometer which utilizes the magnetic analysis of protons recoiling from a thin polyethylene radiator. The spectrometer will cover an energy range from 0.5 to 17 MeV with a single magnetic field setting. The spectrometer has an array of 40 solid-state detectors placed along the focal line and includes the associated electronics. This provides the instrument with the capability of measuring the entire spectrum from either pulsed or steady state sources. Measurements of the neutron spectrum with the reactor in the steady state mode were made using four radiators of different thicknesses. Measurements were made of the power output of the reactor in the pulse mode. The width of the reactor pulse was measured to be 11.0 ms (full width at half maximum). (auth)

35706 (CEND–111) CEND CRITICAL FACILITIES OPERATIONS MANUAL. BONUS CRITICAL EXPERIMENT. Knapp, R. W. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.). Nov. 21, 1960. Contract AT(11-1)-795. 80p. Dep. CFSTI.

An operations manual for the BONUS critical experiment is presented. Outlines are given for: duties and organization of staff, reactor facility, operating procedures, ground rules for operation, health physics procedures, emergency procedures, responsibility, logs and records, and security and visitor control. (M.L.S.)

35707 (CNEA–184) ANALISIS DE EXPERIENCIAS DE RETICULADOS CON MODERADOR LIQUIDO, EMPLEANDO UNA TEORIA A DOS GRUPOS MODIFICADA. (Analysis of Experiments With Liquid Moderated Lattices Using Modified Two-Group Theory). Solanilla, Roberto (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1967. 64p. (In Spanish). Dep.

The computation of the effective multiplication from the geometric experimental observed bucklings in 141 regular lattices moderated and reflected with a liquid (heavy or light water) at ambient air temperature of natural uranium or slightly enriched in U-235 in cylindrical sheathed rods is given. The results show that a modified diffusion two-group theory generated by a condensation of a diffusion four-group model "standard" (with cross section adjusted from the detailed methods to diffusion multigroups and nuclear data) and with simplified equations for the latticed parameters treatment is valid in initial reactivities prediction for "simple" systems moderated with light or heavy water and composed with regular "pressure vessel" type lattices. The method extension for cluster geometry (pressurized tube type lattices) including the burnup calculation is made. (auth)

35708 (DRP/ML/FAR R–187) PHENIX: VERSION INTEGREE. DESCRIPTIF DES CUVES PRINCIPALE ET DE SECURITE. (Phenix: Integrated Version. Description of Main and Safety Vessels). Robin, M. G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb. 10, 1966. 8p. (In French). Dep.

The main and the safety tanks for the Phenix reactor (pot concept) are described and the general drawings are included in the report. (auth)

35709 (EUR–3484.e) CHARACTERISTICS AND DESIGN OF A FACILITY FOR K-inf MEASUREMENTS ON D_2O LATTICES IN THE RB-1 REACTOR. Casali, F.; Casini, G.; Cenerini, R.; Cordani, G.; Rustichelli, F.; Sturm, B.; Zappellini, G. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo). June 1967. 32p. Dep.

The design of a facility which has been mounted in the RB-1 reactor to allow k-inf measurements of D_2O lattices by PCTR techniques is given. K-inf measurements on ORGEL lattices are complementary to the buckling measurements performed at the Euratom Ispra JNRC on exponential (EXPO) and critical (ECO) facilities. The neutronic design criteria of the facility, with particular reference to the errors introduced in the measurements by neutronic flux non-flatness and spectrum mismatch in the test cell, is discussed. Design of the facility according to the experimental requirements, with special regards to some characteristic components is presented. (auth)

35710 (EURAEC–1866) STUDY OF FISSION GAS RELEASE FROM UO_2 SAMPLES IRRADIATED AT DIFFERENT DOSES. Quarterly Report No. 6, January–March 1967. Baffigo, V.; Gerevini, T. (comps.) (Societa Ricerche Impianti Nucleari, Saluggia

(Italy). Centro Ricerche Nucleari). May 1967. Contract 043-65-TEEI(RD). 13p. (EUR-3370). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Eleven experiments were completed on different samples of UO_2 irradiated with various doses at 1400°C. The values obtained are tabulated. (auth)

35711 (EURFNR-315) AN ANALYSIS OF ERRORS INVOLVED IN THE SUB-PROMPT CRITICAL TRANSIENT EXPERIMENTS IN SEFOR. Hutchins, B. A.; Ott, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Feb. 1967. 29p. (KFK-578). Dep.

Work Performed under United States–Euratom Fast Reactor Exchange Program.

An investigation of the errors in the Doppler coefficient (γ, \$/MWsec) resulting from an analysis of subprompt critical transients revealed error in the overall calibration d ϕ_s/ϕ_s; errors in the delayed neutron data appearing essentially in the forms of β (equal to 1 \$) and $\bar{\lambda}$, the average decay constant; and error in the relative power measurement, ψ. The average statistical error in $\bar{\lambda}$ was computed to be about 4%. (J.C.W.)

35712 (GEAP-4680) MIXED SPECTRUM SUPERHEATER CRITICAL EXPERIMENT COUPLED REACTOR MEASUREMENTS. Wall, I. B.; Warzek, F. G. (General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.). Nov. 1965. Contract AT(04-3)-189. 155p. Dep. CFSTI.

An experimental program has been conducted in the Mixed Spectrum Critical Assembly to measure integral and differential parameters in the central fast spectrum zone to establish the reactor physics characteristics of the coupled fast-thermal reactor, and to demonstrate concept feasibility. The Mixed Spectrum Superheater Reactor concept consists essentially of an annular boiling water reactor coupled to a central fast spectrum superheater. The following parameters were determined in the fast spectrum; the neutron spectrum between 12.5 and 115 keV using a proton recoil chamber, the neutron spectrum between 0.14 and 2950 eV using six resonance detectors, the Doppler effect by the activation and reactivity methods, reactivity worths of small samples using an oscillator, and fission ratios of U-233, U-234, U-235, U-236, and Np-237 using small solid state diodes. Since all these measurements were performed at essentially the same location, the integral reaction and reactivity data are consistent with the spectrum determination, an important fact in evaluating fast reactor cross section data. Extensive comparative calculations have been performed. Further experiments, e.g., superheater flooding, fuel compaction effects, power distribution control at superheater-boiler interface, and power split control, were made to demonstrate the feasibility of the concept. In all aspects, the measured effects were significantly within the limits established by the earlier feasibility evaluation. (auth)

35713 (GEMP-402) NASA CAVITY REACTOR CRITICAL EXPERIMENT: FINAL SAFETY ANALYSIS REPORT. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation). Jan. 12, 1966. Contract AT(40-1)-2847. 132p. Dep. CFSTI.

A description and safety analysis of a reflector moderated cavity reactor critical experiment to be operated at the Low Power Test Facility at the National Reactor Testing Station is given. The experimental core assembly will be mounted upon the split-table structure formerly used for the HOTCE critical experiment at this same facility. The proposed cavity reactor experiment will use the nuclear instrumentation and control system from the 630A Maritime Nuclear Steam Generator Critical Experiment, recently concluded, and also will be operated in the same test cell, by the same personnel and in accordance with essentially the same operating procedures and control limits as this latter experiment. Thus, although the nuclear core and reflector moderator are new, all other facilities, systems and procedures involved in the operation of the experiment are previously tested and proven. Potential nuclear accidents and radiological hazards are analyzed and found to be no more probable and considerably less severe than those of other experiments conducted at the LPT Facility. It is concluded that the conduct of this experiment will not create undue hazards to humans, either on or off-site. (auth)

35714 (GEMP-402(Add.1)) NASA CAVITY REACTOR CRITICAL EXPERIMENT: FINAL SAFETY ANALYSIS REPORT. ADDENDUM NO. 1. OPERATION WITH A UF_6 CORE. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation). Feb. 28, 1967. Contract AT(40-1)-2847. 26p. Dep. CFSTI.

A summary of experience gained in the operation of the Cavity Reactor Critical Experiment Assembly with sheet fuel mockups of gas core configurations is given. The operation of the assembly with a UF_6 core presents different handling problems but no real hazards of a type that cannot be controlled by conventional methods. The assumptions used in the calculation of a maximum credible nuclear excursion and the radiological effects of the assumed excursion are conservative. A damaging excursion could only be the result of multiple equipment failure and failure to adhere to established procedures. The probability of such an occurrence is very small; essentially no different than that for other critical experiments performed at the LPTF. In the unlikely event that an accidental excursion occurs, the 27 megawatt-sec energy release is small compared to the 80 megawatt-sec accident calculated for the sheet fuel mockup of a gas core as described in GEMP-402. It is concluded that operation of the Cavity Reactor Critical Experiment with a UF_6 gaseous core can be carried out safely, as planned, and that the alterations in the experimental assembly and its operation represent an insignificant change from the standpoint of safety. (auth)

35715 (GEMP-522) TEST PROGRAM AND STANDARD REACTOR OPERATING AND MAINTENANCE PROCEDURES FOR THE PBF CRITICAL EXPERIMENT REACTOR AT THE LOW POWER TEST FACILITY. Sims, F. L. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation). June 2, 1967. Contract AT(40-1)-2847. 53p. Dep. CFSTI.

A description of the Power Burst Facility reactor, controls, and instruments is given. Operating procedures and safeguards are outlined. Maintenance is discussed briefly. The test program and procedures are sketched. (M.L.S.)

35716 (IAEA-3498-18) PROGRESS REPORT OF NORA PROJECT, APRIL 1–JUNE 30, 1967. (Institutt for Atomenergi, Kjeller (Norway)). July 1967. Contract 104/R2/US. 16p. (NC-89). Dep. CFSTI.

Pulsed neutron research, work on grey control elements, and research on cell parameters are discussed. Theoretical methods for the interpretation of the black and grey absorber elements experiments are presented. Reactivity calculations are compared with experimental results. Measurements of the fast advantage factor in light water lattices have continued. Results for the lattice pitch 2.314 cm have been summarized. (J.C.W.)

35717 (IN-1102) HYDRAULIC AND THERMAL CALCULATIONS FOR A TUBULAR SAMPLE. Millsap, D. A. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Mar. 20, 1962. Contract AT(10-1)-205. 30p. Dep. CFSTI.

Various tubular samples have been designed for irradiation in the MTR. These include Th, ^{233}U, ^{239}Pu, and Th–^{233}U samples. In general, the tubular design gives a proportionately greater cooling surface per unit weight than does a solid sample. The applicable equations are listed and the procedures for making heat production, hydraulic, and heat transfer calculations for any tubular sample to be irradiated in an X-basket or similar sample holder are described. The calculations on the PAED-39 Th capsule are presented by way of illustration of the use of the method. Hydraulic calculations and test results are also given for a mockup experiment. (auth)

35718 (IN-1104) STATUS REPORT ON THE MTR THORIUM PROGRAM. Nisle, R. G. (Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.). Apr. 1965. Contract AT(10-1)-205. 21p. Dep. CFSTI.

A program of studies on the ^{232}Th–^{233}U irradiation chain has been under way at the Materials Testing Reactor since 1951. The early part of this program was directed toward the production of ^{233}U. Beginning in 1955, with the completion of the Reactivity Measurement Facility, a series of measurements of reactivity changes resulting from the irradiation of ^{232}Th was begun. The large solid slugs of Th initially available proved to be unsatisfactory for this program and two new designs were developed. The first design failed during irradiation and an improved design was developed and is currently being fabricated. Improvement in computational techniques and the availability of the more precise Advanced Reactivity Measurement Facility for the measurement of the effective nuclear constants have led to the conclusion that a reorientation of the program objectives is in order. These recommended objectives broadly stated are (1) the measurement of basic data on cold, clean samples, and (2) measurements of irradiation induced reactivity and effective eta changes in Th, Th–^{233}U, and Th–natural U samples typical of those that might be used in a converter or breeder power reactor. A concurrent program of computations should be pursued to compare predictions with experimental results. (auth)

35719 (KR-117) THE SECOND NPY INTERNATIONAL ADVANCED SUMMER SCHOOL ON REACTOR PHYSICS. Interpretation, Analysis, and Utilization of Reactor Physics Experiments in Thermal Neutron Critical and Subcritical Assemblies, Sandefjord, Norway, 22nd August–2nd September 1966. (Institutt for Atomenergi, Kjeller (Norway)). [1966]. 391p. Dep.

The concept of material buckling in reactor theory starting from elementary monoenergetic diffusion theory is discussed. This is done by considering the nature of the solutions of the time-independent neutron balance equation for an infinite, homogeneous, isotropic, multiplying medium. The generalization to heterogeneous or non-isotropic media is also discussed. It is found that the solution to the general equation, which admits both positive and negative flux densities, is equivalent to the solution of a certain eigenvalue equation. The principal eigenvalue of this equation is the buckling, and the associated eigenfunction leads to the most persistent form of the neutron flux. The concept of geometrical buckling is introduced by considering the eigenvalues of the equation $\nabla^2 f + \mu^2 f = 0$, assumed to hold in a given closed spacial region and to vanish on the boundary. The geometrical buckling is the principal eigenvalue of this problem, and the associated eigenfunction is the only solution with no nodal surface in the region. In the diffusion approximation, the time-independent flux in a bare reactor must be the principal eigenfunction of both equations and the two principal eigenfunctions must be identical. The implications for the time-dependent equation and for the theoretical problem of the search for k_{eff} are considered. The material buckling as a useful characterization of the measurement of reproducing properties of a medium is discussed. The standard single region and reflected exponential experiments are discussed. The difficulty in practice posed by the presence of spacial transients is reviewed, and the inherent error in buckling and k_{eff} are estimated in specific cases. The use of the measured data in the theory is described. (auth)

35720 (NAA-SR-9780(Add.1)) ANALYSIS OF SNAPTRAN-3 DESTRUCTIVE EXPERIMENT. Rhoades, W. A. (Atomics International, Canoga Park, Calif.). Mar. 31, 1967. Contract AT(04-3)-701. 5p. Dep. CFSTI.

The data and methods used for the SNAPTRAN-1 and -2 analysis were successful in predicting the SNAPTRAN-3 temperature coefficient of reactivity. The SNAPTRAN-3 coefficient is found to have a somewhat smaller long-period value, coupled with a much larger increase with large inverse periods. It is concluded that the experimentally determined SNAPTRAN-3 coefficient was not anomalous in a physical sense. It is only necessary to do a proper spatially dependent kinetics calculation with currently accepted cross-section data to arrive at agreement between theory and experiment. (auth)

35721 (NP-16736) CALCULO DEL SISTEMA DE ENFRIAMIENTO DEL REACTOR NUCLEAR TRIGA MARK III. (Calculation of the Cooling System of the Triga Mark III Nuclear Reactor). Gomez Santa Maria, Juan Eugenio (Universidad Nacional Autonoma de Mexico, Mexico City. Escuela Nacional de Ciencias Quimicas). 1964. 83p. (In Spanish). Dep.

Thesis.

The solution to the problem of increasing the capacity of the cooling system of the Triga Mark III reactor is discussed. The characteristics of the cooling equipment necessary to remove 5 Mw of heat from the reactor were determined. Costs of the cooling tower for the water used as a coolant in the heat exchanger were calculated. The adequate and economic modifications that must be made to the cooling equipment already purchased, whose coolant capacity is only 1 Mw, were indicated. (J.S.R.)

35722 (NP-16853) POSSIBILITIES FOR ZONING A 1700 LITERS, SODIUM-COOLED FAST REACTOR FOR MEASURING THE SODIUM VOID COEFFICIENTS AND THEIR CONSEQUENCES ON THE EXPERIMENTAL RESULTS. Durand-Smet, R. A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Reaktorphysik). [1965]. 72p. (PSB-243). Dep.

Practical problems of importance for the design of a critical mock up reproducing a fairly large, sodium-cooled reactor fueled with UO_2-PuO_2 are investigated theoretically. The main problems concern the errors on the measured sodium void effects caused by the presence of a driver fueled with uranium in the largest part of the assembly, the necessity of limiting the zone of sodium voiding to a small part of the assembly, and the influence of a simplified reflector composition. The calculations are carried out with multigroup diffusion theory in one and two dimensions. The cross section set used principally is the 26 group set developed in Karlsruhe. Emphasis is placed mainly on the measurements made along the core axis (sodium danger-coefficients) and throughout the whole core (sodium void- or sodium density-coefficient). (auth)

35723 (ORNL-TM-1821) CALCULATIONS OF THE POWER DISTRIBUTIONS IN THE TOWER SHIELDING REACTOR II. Wilson, J. H.; Holland, L. B. (Oak Ridge National Lab., Tenn.). 1961. Contract W-7405-eng-26. 19p. Dep. CFSTI.

The power distribution and heat flux of the TSR-II fuel plates have been calculated for the final core configuration which includes the fuel-bearing cover shell on the control mechanism housing. Calculations for the clean-cold condition of the reactor were based on gold foil activation measurements of the thermal-neutron density distribution in the core and those for high-power operation were based on GNU-II code calculations for the thermal-neutron density distribution. The data are presented for operation of the reactor at 1 MW. (auth)

35724 (RISO-137) LEAKAGE MEASUREMENTS OF THE DR 3 CONTAINMENT DURING REACTOR OPERATION TO MEET A DEMAND OF MAXIMUM 0.1 PERCENT LEAKAGE PER 48 HOURS. Haack, Karsten (Danish Atomic Energy Commission, Risoe. Research Establishment). Dec. 1966. 17p. Dep.

The ratio between the absolute temperature T and the partial pressure P of the atmospheric air in the hall is taken as a representative of the number of air moles present. A plot versus time gives the leak rate. The temperature is measured by means of an Fe wire through the hall; the pressure is determined by projecting the Hg surface of a precision manometer onto a screen. The arrangements and the measurement equipment are described and the uncertainties of the results discussed. The experiences from six yearly tests have led to a method which is considered to be more convenient than that used previously, and yet sufficiently accurate to control the tightness of the DR 3 reactor building. (auth) (UK)

35725 (TRG-Report-1453) DESIGN, DEVELOPMENT, AND MANUFACTURE OF NEUTRON CONVERTORS FOR D.M.T.R. Lorimer, W. R.; Pearson, T. G. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). Feb. 23, 1967, Revised Apr. 5, 1967. 20p. Dep. CFSTI. UK 2s. 6d.

Three designs of neutron convertors have been manufactured for use in the Dounreay Materials Testing Reactor. Two are for installation in 4VGR facilities, and the third in a 4V facility hole. A further type is being designed for use in a 7V facility. Experience with the first convertor highlighted difficulties and indicated areas of improvement in design concepts. A description of the designs, together with manufacturing and commissioning experiences, is presented, and the solutions are adopted in overcoming difficulties. (auth) (UK)

35726 NARF EFFLUENT MONITORING SYSTEM. Draper, W. E. (General Dynamics/Fort Worth, Tex.). Trans. Amer. Nucl. Soc., 10: Suppl., 1-2(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11-15, 1967. See CONF-670602.

35727 SAFETY ANALYSIS OF POOL REACTORS. Rust, J. H.; Dahlheimer, J.; Meem, J. L. (Univ. of Virginia, Charlottesville). Trans. Amer. Nucl. Soc., 10: Suppl., 3(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11-15, 1967. See CONF-670602.

35728 SCRAM REDUCTION AT THE GENERAL ELECTRIC TEST REACTOR. Larson, H. J.; Darmohray, G. F. (General Electric Co., Pleasanton, Calif.). Trans. Amer. Nucl. Soc., 10: Suppl., 3-4(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11-15, 1967. See CONF-670602.

35729 RELATING OPERATING EXPERIENCE, PREVENTIVE MAINTENANCE, AND RELIABILITY ANALYSES. Zanot, John R. (General Electric Co., Pleasanton, Calif.). Trans. Amer. Nucl. Soc., 10: 4-5(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11-15, 1967. See CONF-670602.

35730 OPERATING EXPERIENCE WITH THE HFIR PROTECTION SYSTEM. Bates, A. E. G.; Epler, E. P.; Oakes, L. C. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 5(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11-15, 1967. See CONF-670602.

35731 DESIGN, INSTALLATION, AND TESTING OF A STAINLESS-STEEL LINER FOR A SWIMMING POOL REACTOR. Feltz, E.; Mason, Paul M.; Randall, John D. (Texas A and M Univ., College Station). Trans. Amer. Nucl. Soc., 10: Suppl., 8(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11-15, 1967. See CONF-670602.

35732 HEAT-EXCHANGER TUBE VIBRATION AND REPAIR IN THE HIGH FLUX BEAM REACTOR. Kinne, Gerald C.; Tichler, Paul R. (Brookhaven National Lab., Upton, N. Y.). Trans. Amer. Nucl. Soc., 10: Suppl., 8-9(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11-15, 1967. See CONF-670602.

35733 PREPARATION FOR REPLACING THE NRU REACTOR VESSEL. Collins, J. H. (Atomic Energy of Canada Ltd., Chalk River). Trans. Amer. Nucl. Soc., 10: Suppl., 9-10(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35734 EXPERIENCE WITH NEUTRON DAMAGE TO BERYLLIUM AND ALUMINUM LATTICE COMPONENTS AT THE ORR. Hurt III, S. S. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 11-12(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35735 LOW-COST SHIM SAFETY ROD FOR POOL-TYPE REACTORS. Martin, Robert D. (Univ. of Michigan, Ann Arbor). Trans. Amer. Nucl. Soc., 10: Suppl., 13(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35736 OPERATING EXPERIENCE WITH THE HFIR THROUGH JUNE 1967. McCord, R. V. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 14(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35737 HFIR COOLANT FLOW ANOMALIES. Scott, R. L. Jr. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 14-15(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35738 POWER INCREASE OF THE OAK RIDGE NATIONAL LABORATORY BULK SHIELDING REACTOR. Stanford, L. E. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 15-16(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35739 PROGRAMMED SAMPLE IRRADIATION SYSTEM. Beidelman, J. A.; Pierce, A. W.; Goetsch, A. H.; Bunce, R. W. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 10: Suppl., 16(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35740 FUEL-PLATE TEMPERATURE MEASUREMENTS AT THE AIR FORCE NUCLEAR ENGINEERING TEST FACILITY. Buoni, Frederick B. (Wright-Patterson Air Force Base, Dayton, Ohio); Fasano, Anthony N.; Hary, Laszlo B.; Hooks, Kenneth R. Trans. Amer. Nucl. Soc., 10: Suppl., 16-18(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35741 SPENT-FUEL SHIPPING PROCEDURE AT MITR. Clark, L. Jr. (Massachusetts Inst. of Tech., Cambridge); Barnett, E. J.; Gosnell, J. W.; Gwinn, D. A.; Karaian, E.; Thompson, T. J.; Brown, S. H. Trans. Amer. Nucl. Soc., 10: Suppl., 18(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35742 A CANTILEVERED GRID CORE SUPPORT TOWER AT THE BATTELLE RESEARCH REACTOR. Bixel, D. A.; Basham, S. J.; Ray, J. W. (Battelle Memorial Inst., Columbus, Ohio). Trans. Amer. Nucl. Soc., 10: Suppl., 18-19(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35743 DESIGN, USE OF, AND OPERATING EXPERIENCE WITH RESEARCH REACTORS AT GENERAL DYNAMICS-FORT WORTH. Ross, D. F.; Pancoast, J. T.; Park, W. (General Dynamics/Fort Worth, Tex.). Trans. Amer. Nucl. Soc., 10: Suppl., 19-20(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35744 OPERATING EXPERIENCE WITH A HIGH-TEMPERATURE GAS-COOLED REACTOR. Brown, C. L. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). Trans. Amer. Nucl. Soc., 10: Suppl., 21-2(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35745 EXPERIMENTAL METHOD OF DETERMINING THE ABSOLUTE POWER LEVEL IN LOW-POWER NUCLEAR REACTORS. Ebert, David D. (Knolls Atomic Power Lab., Schenectady, N. Y.). Trans. Amer. Nucl. Soc., 10: Suppl., 23(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35746 APPLICATIONS OF AN INVERSE KINETICS COMPUTER PROGRAM TO THE MEASUREMENT OF REACTIVITY. Talboy, James H.; Savio, Richard P.; Herbst, Dale A. (Argonne National Lab., Ill.). Trans. Amer. Nucl. Soc., 10: Suppl., 23-4 (June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35747 ENGINEERING TEST REACTOR FLUX STABILIZATION. Burdick, E. E.; Forrester, R. J.; Mackley, A. D. (Idaho Nuclear Corp., Idaho Falls). Trans. Amer. Nucl. Soc., 10: Suppl., 25-6(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35748 TSR-II CONTROL MECHANISM DEVELOPMENT AND OPERATIONAL EXPERIENCE. Holland, L. B.; Ward, D. R. (Oak Ridge National Lab., Tenn.). Trans. Amer. Nucl. Soc., 10: Suppl., 27(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35749 AF NETF PRIMARY-COOLANT CONDUCTIVITY STUDY. Baker, John W.; Hary, Laszlo B.; Fasano, Anthony N.; Buoni, Frederick B. (Wright-Patterson Air Force Base, Dayton, Ohio). Trans. Amer. Nucl. Soc., 10: Suppl., 27-9(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35750 FUEL-ROD-FAILURE EXPERIENCE DURING TRANSIENT TESTING. Whitener, H. L.; Stephan, L. A. (Phillips Petroleum Co., Idaho Falls, Idaho). Trans. Amer. Nucl. Soc., 10: Suppl., 32-3(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35751 TECHNIQUES FOR RECRUITING AND MAINTAINING A RESEARCH REACTOR OPERATIONS STAFF. Link, Bruce W. (Ames Lab., Iowa). Trans. Amer. Nucl. Soc., 10: Suppl., 36-7(June 1967).
From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35752 POWER NOISE SPECTRA OF A WATER REACTOR IN LOW-FREQUENCY REGION. Utsuro, Masahiko; Shibata, Toshikazu (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 4: 267-72(June 1967).

The power noise measurements were carried out on the Kyoto University Reactor at various reactor power levels under natural convection for two kinds of core configuration with different temperature coefficients of reactivity. Analysis of the results revealed strong noise in the low frequency region at higher levels, even with a core configuration of essentially zero temperature coefficient of total reactivity. A conventional theoretical model assuming a white noise input in reactivity and a reactor transfer function with temperature-reactivity feedbacks was adopted for comparison with the observed data, but it resulted in considerable disagreement at higher power levels. It is concluded that other power effects not yet clarified exist in the reactivity feedbacks or in the noise inputs to the reactor, which are responsible for the experimental noise spectrum distortion in the low frequency region. (auth)

35753 "RAPSODIE", THE FRENCH FAST NEUTRON REACTOR. Vendryes, Georges; Denielou, Guy (CEA, Paris). Ind. At., 11: Nos. 5-6, 49-51(1967). (In French).

Integrating Rapsodie within the fast reactor program in France is discussed. The preliminary studies and the construction of the reactor are given. The results obtained during the final stage of the start-up and those expected during operation are outlined. A brief comment on the Phenix reactor is included. (auth)

35754 THE CONSTRUCTION OF "RAPSODIE". Rosenholc, Michel; Chauvin, Michel (CEA, Paris). Ind. At., 11: Nos. 5-6, 53-9(1967). (In French).

The main construction phases of Rapsodie, from the decision to erect the reactor at Cadarache to the beginning of the start-up and to the moment when the reactor became first critical are described. The essential features of Rapsodie and the difficulties encountered during its construction are discussed. (auth)

35755 SOME ASPECTS OF THE DRIVE-CONTROL OF "RAPSODIE". Chapelot, Andre; Lelait, Roland (CEA, Paris). Ind. At., 11: Nos. 5-6, 60-70(1967). (In French).

Some of the aspects of the control system and the general principles of the automation design are discussed. The safety mechanisms applied in the control of components of the plant and in safety operations, however, demand much more elaborate technological structures and methods. The importance of the conventional measuring and regulation devices is stressed. Some specific control and measuring systems designed for operation with sodium are described. A data processing system completes the classical indicating units and assumes the more subtle control and processing operations. (auth)

35756 THE DESIGN OF THE THERMAL CIRCUITS OF "RAPSODIE", SPECIAL PROBLEMS LINKED TO THE USE

OF SODIUM. Velin, Francois (CEA, Paris). Ind. At., 11: Nos. 5-6, 71-6(1967). (In French).

Sodium is applied for heat transfer in fast reactors. This liquid metal appears to be most suited for transferring the thermal energy from the core to the vapor generators. The design of the Na cycle is simple; it requires pre-heating and a sodium oxide purification plant. (auth)

35757 THE HANDLING OF THE FUELS FOR "RAPSODIE" AND THE EFFECTS OF THE PRESENCE OF SODIUM. Mulot, Pierre (CEA, Paris). Ind. At., 11: Nos. 5-6, 77-83(1967). (In French).

The general aspects of the handling and maintenance of fuel and irradiated elements with the reactor Rapsodie and the main difficulties encountered with the equipment used for handling of fuel assemblies in the presence of Na are discussed. (auth)

35758 THE CONTROLS ON "RAPSODIE". Chauvin, Michel (CEA, Paris). Ind. At., 11: Nos. 5-6, 84-6(1967). (In French).

On the basis of some aspects of the control of equipment, components and systems during a short inspection, the control work on the reactor Rapsodie is discussed. (auth)

35759 THE TESTING AND STARTING UP OF "RAPSODIE". Pontier, Robert (CEA, Paris). Ind. At., 11: Nos. 5-6, 87-91 (1967). (In French)

The startup of the reactor Rapsodie is described. Main phases of the course of tests undertaken, problems encountered, and results obtained are listed. (auth)

35760 BURNUP DETERMINATION IN AN L-54 WATER-BOILER REACTOR FROM BUILDUP OF TRITIUM IN ITS RECOMBINER WATER. Lazzarini, E. (Politecnico, Milan). Nucl. Sci. Eng., 29: 145-7(July 1967).

A method for determination of burnup by sampling of recombiner water in the L-54 reactor is given. The advantages are discussed; the disadvantages are pointed out. Measurement techniques are briefly discussed. (M.L.S.)

35761 REACTOR PHYSICS POINTS OF VIEW FOR ESTABLISHING OF COLD NEUTRON CHANNEL. Bata, Lajos (Central Inst. of Physical Research, Budapest). Energ. Atomtech., 19: 561-76(Nov.-Dec. 1966). (In Hungarian).

Study of the microdynamics of condensed systems — solids, liquids, magnetic materials, etc. — requires a reactor channel with a high cold-neutron flux with a relatively low high-energy neutron and γ flux background. Heavy-water reactors yield the highest thermal-neutron flux per unit productivity; the nature of the flux is affected by the type of reflectors used, position of the channels, and the angular distribution of the neutrons. The length of the channel depends on the dimension of the biological shield. A cold, <0.005 eV neutron beam may be created by means of Bragg reflection, using a single crystal, a curved-slit neutron chopper or a polycrystalline neutron filter. In the VVR-S reactor, the distance between the neutron filter and the core was kept as short as possible. The cold neutron channel was formed at the graphite thermal column; the neutron chopper was located within the core. The specimens tested were placed in slots within the shield, placing a 1.5-m wide water lock in front of the polycrystalline Be filter. The neutron and γ fluxes were calculated from the design data, in order to obtain the needed dimensions for the shield. (TTT)

35762 LOOP EXPERIMENTS IN ZONES OF NUCLEAR POWER PLANTS. Mathe, Ivan Gyoergy; Selley, Gabor. Energ. Atomtech., 19: 390-8(Aug. 1966). (In Hungarian).

The General Electric Test Reactor contains 5 loops for testing the suitability of He as cooling agent; the parallel loops are located outside of the core, in a low neutron-flux position and are provided with canned-rotor circulating pumps. In the BMI-16 fuel element testing loop, cooling by means of 820°C exit temperature N_2 gas is investigated; the concentric pipe arrangement of the system is also used as a regenerative heat exchanger. The 2 parallel loops of the VVR-2 reactor are used for studying the efficiency of cooling by CO_2; the outleaking gases are collected in a closed container. The loop installed in the Czechoslovak VVR-S reactor is provided with an electrostatic field, applied in vertical direction with respect to the outside heat-generating surface of the fuel elements. Some loops are used for the production of radioisotopes and for special purposes, as the organic-cooling loop in the Canadian WR-1 reactor or the superheat loop installed in the German Kahl reactor. Condensed-gas-cooled loops allow the examination of solids and liquids at low temperatures with "cold," low-energy neutrons. Loop tests were used to study the decomposition of hydrocarbon coolants in high radiation fields and the cracking of polymers. Loops with liquid-metal cooling served to determine the corrosive behavior and general technological parameters of this medium. Fast reactor cooling problems were also investigated by a loop system installed in the U. S. Advanced Test Reactor. The energy spectrum of a thermal reactor may be distorted by installing absorbing screens. Molten salt systems have also been built. (TTT)

35763 PHYSICS OF SPECTRAL SHIFT REACTORS. Edlund, Milton Carl. Ann Arbor, Univ. of Michigan, 1966. 137p.

Thesis.

The experimental and theoretical work on the physics of spectral shift control of pressurized water reactors is summarized. The coolant-moderator in these reactors is a mixture of light and heavy water, the proportions of which are changed to control reactivity as the reactor operated. The effect of D_2O on criticality and reaction rates was determined by measurements of buckling, cadmium fission ratios of ^{235}U, and epi-cadmium to sub-cadmium activation ratios of ^{238}U in critical assemblies of low-enriched uranium fuel. The experimental results were used to check the adequacy of nuclear design calculations. Multi-group diffusion methods similar to those which have been successfully applied to design light-water moderated reactors are shown to be adequate for designing spectral shift reactors. The multi-group equations for the fast neutron spectrum are developed from the Boltzmann equation using the Greuling–Goertzel neutron slowing-down model in conjunction with a consistent P-1 approximation. Resonance absorption is calculated using the integral method of Chernick, and the thermal neutron spectrum and spatial flux distribution in a lattice cell are computed using Honeck's integral equation method. The calculation model, as determined by the correlation of the integral data from the critical experiments, is entirely adequate for design purposes. (auth)

35764 METHOD FOR THE ANALYSIS OF THE DYNAMIC RESPONSE OF A SMALL BERYLLIUM REFLECTED REACTOR. Fitzgerald, Duane Glenn. Columbia, Mo., Univ. of Missouri, 1966. 95p.

Thesis.

A simple method is developed to analyze the dynamic response of a small Be reflected nuclear reactor to rapid changes in reactivity. In the future the University of Missouri Research Reactor may be modified to permit operating it in a pulsed mode. This reactor has a Be reflector which is a source of neutrons. Equations are developed for the analysis of the profile of the power pulse resulting from a large and rapid reactivity insertion, with particular emphasis on the inclusion of the $^9Be(n,2n)^8Be$ reaction as a neutron source in the reflector. The equations produced are applicable to small systems which may be represented by space-independent kinetics. A spherically symmetric reactor system is analyzed and simulated on an analog computer. Results are presented for the simulation of several step and linear ramp reactivity insertions for the case of no reflector source and for the case of a large reflector source. (auth)

Production Reactors

35765 (DUN-SA-34) HYDRIDING OF HANFORD PRODUCTION REACTOR ZIRCALOY PROCESS TUBES. Alexander, W. K. (Douglas United Nuclear, Inc., Richland, Wash.). June 16, 1967. Contract AT(45-1)-1857. 15p. (CONF-670713-1). Dep. CFSTI.

From 3rd Meeting of the Reactor Operations Division of the American Nuclear Society, Atlantic City, N. J.

Metallurgical and chemical analyses of the Zircaloy-2 process tubes at Hanford Production Reactors confirmed the existence of hydride. A description of the existing conditions and the methods of correction are discussed. (J.C.W.)

35766 (RL-SA-76) OPERATING EXPERIENCE WITH IN-LINE WATER ANALYZERS AT N-REACTOR. Fowler, K. L.; Lewis, M. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). June 6, 1967. 8p. (CONF-670620-4). Dep. CFSTI.

From Northwest Regional Meeting of the American Chemical Society, Richland, Wash.

In addition to normal bench analysis facilities at N-Reactor, an in-line analyzer package was installed. The package included a sample conditioning system, and O_2, radiation, hydrazine, H_2, chloride, Na, pH, and conductivity analyzers with strip recorders located in a single panel board. Modifications were made to the sample conditioning system to increase reliability and provide clearner samples. Changes in water treatment eliminated the need for two gas chromatographs. Conductivity equipment has proved to be the most reliable and valuable. The radiation and Na packages have operated satisfactorily. O_2 equipment gave many problems because of the low conductivity water but now functions well. The low level H_2 analyzer has operated satisfactorily. Hydrazine and chloride analyzers are not yet satisfactory. The pH equipment appears to be correctable with a new electrode cell. Plans are being made to provide a few repeating recorders

in the control room and to provide data transmitting equipment between the laboratory and control room. (auth)

35767 HYDRIDING OF HANFORD PRODUCTION REACTOR ZIRCALOY PROCESS TUBES. Alexander, W. K. (Douglas United-Nuclear, Inc., Richland, Wash.). Trans. Amer. Nucl. Soc., 10: Suppl., 12-13(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

35768 OPERATIONAL STAFFING AND TRAINING PROBLEMS FOR THE STARTUP OF N REACTOR. Lewis, D. S. (General Electric Co., Richland, Wash.). Trans. Amer. Nucl. Soc., 10: Suppl., 35-6(June 1967).

From 13th Annual Meeting of the American Nuclear Society, San Diego, Calif., June 11–15, 1967. See CONF-670602.

Reactor Components, Fuels and Accessories

Refer also to abstracts 34222, 34523, 34951, 35390, 35536, and 35583.

35769 (AAEC/TM-366) FORTRAN IV PROGRAMMES FOR COMPUTATION OF TEMPERATURE AND THERMOELASTIC STRESS IN A HOMOGENEOUS SPHERICAL FUEL ELEMENT DUE TO AXISYMMETRIC HEAT TRANSFER VARIATION OVER THE SURFACE. Holy, Z. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1967. 43p. Dep.

Computer programs together with a brief outline of the theory are presented which enable computation of temperature and thermoelastic stress fields in homogeneous spherical fuel elements due to axisymmetric heat transfer variation over the surface. Uniform heat generation in the fuel element is assumed. (auth)

35770 (AAEC/TM-371) TEMPERATURES AND THERMOELASTIC STRESS IN SPHERICALLY SYMMETRIC FUEL ELEMENTS WITH VARYING MATERIAL PROPERTIES. Binns, Ian M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Feb. 1967. 26p. Dep.

In the thermo-elastic stress analysis of a spherically symmetric fuel element as used in a pebble bed reactor the problems of a radial variation in material properties and the temperature dependence of these properties can be unified into a single analysis. Such an analysis is developed for incorporation in a computer program and applied, as an example, to a fuel element for a BeO moderated reactor. The results give the effect of different material properties between surface and center, a buffer layer between surface coating and center, an increase in temperature of a fuel element composed of materials with different properties, and temperature dependence of the fuel element materials. (auth)

35771 (AD-650428) NEW APPROACH TO TRANSPORT THEORY. Shiffman, Bernard (RAND Corp., Santa Monica, Calif.). Oct. 1964. Contract SD-79. 29p. (RM-3862-1-ARPA). CFSTI.

A complete mathematical definition of an abstract linear transport process is given in terms of a new axiomatic system. After several preliminary theorems are proven, the basic algebraic equations relating the "transport operators" are derived, and the semigroup properties of these equations are indicated. These algebraic equations are then used to derive the standard differential equations describing a transport process. The generalized invariant-imbedding equations are used to describe an energy-dependent, neutron-transport process. (auth)

35772 (AD-650529) NUCLEAR REACTOR CALCULATIONS AT DAVID TAYLOR MODEL BASIN. Bareiss, Erwin H. (David Taylor Model Basin, Carderock, Md. Applied Mathematics Lab.). Feb. 1957. 35p. (DTMB-1101). CFSTI.

Two representative projects involving nuclear reactor calculations performed on electronic computers are discussed. The first, leading to the Cuthill code, is based on the diffusion theory and the second is based on the more refined transport theory. The mathematical procedures underlying these approaches to the solution of problems in reactor design are described in detail. (auth) (TAB)

35773 (AD-650544) A CLASS OF SCIENTIFIC APPLICATIONS ON LARC. Cuthill, Elizabeth; Schot, Joanna Wood (David Taylor Model Basin, Carderock, Md. Structural Mechanics Lab.). June 1958. 23p. (DTMB-1248). CFSTI.

Large data handling and storage problems are encountered in the preparation of codes for the solution of systems of elliptic partial difference equations on a three-dimensional network when the number of points is of the order of 50 × 50 × 50. The solution of such systems of equations comprises one part of FLAME, a multigroup burnout code for LARC prepared for the prediction of the time-dependent neutron distribution in a nuclear reactor. Seven-point difference equations are used. Coefficients in these difference equations are permitted to vary pointwise so that solutions for nonhomogeneous reactors can be obtained. The form in which the coefficients are stored is a function of the numerical method used. Efficient methods of solution require fast access storage for the order of 1,000,000 values. This is possible using the LARC drums. On LARC, computation in the central computer can be performed concurrently with data-transfer operations between drums and core storage. Because of the relative speeds of these functions, it is shown that with the proper choice of method an almost perfect balance between computation time and data-transfer time can be achieved. (auth)

35774 (BMI-1808) DESIGN OF A CAPSULE FOR IRRADIATION NEAR 2000 C. Zielenbach, William J.; Ray, Joseph W. (Battelle Memorial Inst., Columbus, Ohio). July 6, 1967. Contract W-7405-eng-92. 24p. Dep. CFSTI.

A capsule was designed for irradiating samples at 1600 to 2000°C at a heat rate of 2.8 kw per ft. A useful range of temperature control was obtained using a binary gas mixture of variable composition in the outer capsule annulus. Heat-transfer studies of various configurations were conducted to determine the best scheme for temperature measurement. In the concept chosen, a sheathed thermocouple was located in a thick section of cladding which was removed from the point of maximum temperature by about 180°C. Two experiments were conducted with additional bare, stranded thermoelements attached to the exterior of the cladding at the point of maximum temperature to verify the predictions. Measured thermal gradients correlated with the predicted values but the overall performance of the sheathed thermocouples was poor. Temperatures of 1700 to 1800°C were obtained. (auth)

35775 (EURAEC-1835) INVESTIGATIONS ON CYCLONES FOR STEAM SEPARATION IN BOILING WATER REACTORS. Quarterly Report No. 5, January 1–March 31, 1967. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main (West Germany). Kernenergieanlagen). 20p. (EUR-3358). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

Investigations into mixture inflow with several rows of steam-separation cyclones located axially to flow in the reactor drop space are detailed. Inflow geometry with mainly horizontal sheet-metal guides to remove a fraction of the mixture flow for each cyclone row were used. The air/water tests in this quarter indicated that sufficiently even mixture distribution could not be guaranteed in all partial load contingencies with adequate certainty. Experimental investigations into mixture distribution were stopped for the moment and cyclone optimisation was initiated. A theoretical investigation intended to: alter the intake geometry to improve mixture distribution; reduce the pressure loss involved in steam removal from the cyclone; to imitate more closely the reactor conditions as regards geometry in the test facility; and simplify separator fabrication. The combination of three steam removal tubes (one from each cyclone row) into a steam removal box was investigated. This assembly did not improve mixture distribution in air/water tests either, even when supplemented with a "compensation section" across the cyclones or a transverse metal-sheet guide. It was, therefore, decided to initiate mixture distribution in the mixture boxes above the core, using appropriate components which constitute a sort of forced mixture guide for each cyclone row. The scope for corresponding tests in the air/water test facility is being explored. (auth)

35776 (EURAEC-1867) THE BOILING WATER CAPSULE. Special Report No. 4. Lhost, A. (Societe Belge pour l'Industrie Nucleaire, Brussels). Apr. 1967. Contract 001-64-1-TRUB. 46p. (EUR-3371). Dep. CFSTI.

Work Performed under United States–Euratom Joint Research and Development Program.

The "boiling water capsule" is an instrumented experimental device regulated by thermal barrier action. It is designed to study the behavior of fuels subjected to irradiation, and is used for irradiations in the Belgian BR-2 reactor, a high-neutron-flux test reactor using light water for moderation and cooling. The boiling water capsule permits continuous measurement of the power generated in a fuel rod subjected to irradiation, and enables the can temperature to be held in the vicinity of a given rated value through pressure regulation. (auth)

35777 (MLM-1387(Suppl.)(Del.1)) DATA SHEETS: ^{238}Pu FUELS. (Mound Lab., Miamisburg, Ohio). July 1, 1967. Contract AT(33-1)-Gen-53. 44p. Dep. CFSTI.

The characteristics of the metal fuel form, oxide microsphere fuel form, oxide form, and zirconium alloy fuel form are summarized by tables and graphs. 26 references. (J.C.W.)

35778 CIRCUMFERENTIAL CLAD RIDGING AT FUEL-PELLET INTERFACES. Fenech, Henri; Gueron, Henri M. (Massachusetts Inst. of Tech., Cambridge). Nucl. Appl., 3: 406-10(July 1967).

A relation between the use of dished pellets and the observation of ridging of clad fuel elements is proposed. An experiment performed on cold Al pellet-shaped pieces is described. This experiment illustrates the idea that dishing may be one of the causes of ridging, and suggests a pellet shape which is expected to reduce this deformation. (auth)

35779 SOME CONSIDERATIONS CONCERNING THE DETECTION OF CLADDING DEFECTS IN NUCLEAR REACTORS. Ionescu, Ecaterina; Alexan, Zamfira (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz., 19: 429-50(1967). (In Rumanian).

The detection methods used include those based on mechanical properties, such as the changes of the flow rate and pressure of the coolant, and radioactive methods based on the detection of the escaping fission product gases. In gas-cooled reactors, the following methods were employed: mechanical filtration of solid fission products; direct measurement of short-life fission gases, and electrostatic collection of the fission gases. The methods used in water-cooled reactors are based on the detection of delayed neutrons emitted by the fission products in the cooling medium, detection of γ emitters of radioactive iodine on ion-exchangers, detection of fission gases after separation from the coolant, and selective detection of certain γ emitters formed by the fission products. The system must be operating automatically, making it possible to identify the defective fuel channel and to indicate the findings on the control panel. (Review article, 32 references). (TTT)

35780 FLUCTUATIONS IN RADIATION DISTRIBUTIONS. Gelinas, Robert Joseph. Ann Arbor, Mich., Univ. of Michigan, 1966. 124p.

Thesis.

A theoretical study of fluctuations in the radiation distributions from systems that are amenable to a transport description is presented. The quantum Liouville equation is used to generate a coupled set of transport equations for the first and second moments of the appropriate numbers (in fact densities) of particles that adequately describe the system. The specific applications considered are (1) a nuclear reactor system on which is observed neutron correlation information by measurements on the high energy prompt gamma radiation field of the reactor core and (2) the Brown-Twiss correlator experiment. The latter system measures fluctuations in a Hg arc source of optical radiation by placing two photocathodes in the beam of radiation. Outputs are fed to a correlator which measures the expectation value of the product of the fluctuations in the output currents. The observables in the reactor noise experiment are a power spectral density and the ratio of the variance to the mean of the accumulated counts from the photon detector. In reactor noise analysis by photon observation, a finite and an infinite reactor-detector model are considered. (J.C.W.)

35781 ROLE OF THE ADJOINT FLUX IN DETERMINING REACTOR STABILITY. Jason, Richard Harry. Lafayette, Ind., Purdue Univ., 1966. 140p.

Thesis.

The conditions required for the boundedness and stability of the output of a reactor system for the situation in which the reactor properties are explicit functions of space and power level are determined. The investigation of this nonlinear problem has been carried out using the methods of time dependent perturbation theory as applied in quantum mechanics. A condition on the perturbation matrix has been found which is sufficient to ensure boundedness in the large of the neutron flux and reaction rates such as power density. This condition can be made to yield equivalent conditions on the adjoint flux. Since the latter obeys a linear equation, it may be simpler to study its behavior as an indicator of the boundedness of the reactor system. (J.C.W.)

35782 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Cole, Leslie Charles (to United Kingdom Atomic Energy Authority). British Patent 1,075,117. July 12, 1967. Filed Apr. 1, 1963.

A nuclear reactor comprising more than one cooled vessel is described. The parallel-connected coolant vessels are designed with removable top closures and a fluid counterflow brake. (J.C.W.)

35783 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUELS. Johnson, James Robert; Sowman, Harold Gene (to Minnesota Mining and Manufacturing Co.). British Patent 1,074,426. July 5, 1967. Filed Sept. 28, 1964.

Fissionable reactor fuels encased in refractory substances can withstand high temperatures and be very resistant to corrosion. Various sizes of the fuel particles affect the use of refractory materials. A method of fabrication is described. (J.C.W.)

35784 NUCLEAR REACTOR FUEL ELEMENTS. Saunders, Allan Charles Anthony; Culshaw, David William; Swift, James David (to United Kingdom Atomic Energy Authority). British Patent 1,075,633. July 12, 1967. Filed May 28, 1963.

Nuclear reactor fuel elements of fissile material enclosed in sheath of non-fissile material are positioned and secured against transverse vibration by a complex of leaf springs. (P.G.C.)

35785 URANIUM ALLOY AND PROCESS FOR ITS PREPARATION. Decours, Jacques; Lerouge, Georges (to CEA). British Patent 1,075,368. July 12, 1967. Priority date June 18, 1965, France.

Tubular U alloy nuclear fuel elements are prepared by melting U with 0.5 to 1.5 wt% Mo in graphite crucibles containing porous refractory linings. The alloy is cast and cooled at a rate between 15 and 30°C per minute. The alloy is homogeneous with fine α and γ grains and may be machined and canned. (P.G.C.)

35786 IMPROVEMENTS IN OR RELATING TO THE PREPARATION OF SPHERICAL OR SPHEROIDAL PARTICLES OF NUCLEAR FUEL MATERIALS. (to United Kingdom Atomic Energy Authority). British Patent 1,076,517. July 19, 1967. Priority date Oct. 14, 1963, Belgium.

Spheroidized particles of nuclear fuels are produced by mixing powdered nuclear fuel material with a polymersible monomer binder, forming the mixture into a thick paste, granulating, and rolling into balls. Use of monomeric binders eliminates formation of volatile products during calcination or sintering and avoids other deleterious effects of commonly used binders such as alcohols, ketones, and camphor. (P.G.C.)

GENERAL

Refer also to abstract 35659.

35787 (BNWL-446) PLUTONIUM ABSTRACTS. Volume 7, Number 4. Russell, Barbara G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Apr. 30, 1967. Contract AT(45-1)-1830. 27p. Dep. CFSTI.

Abstracts (56) that contain information about plutonium studies in the areas of biology and medicine, chemistry, health and safety, metallurgy and ceramics, physics, and reactor technology are presented. (B.H.S.)

35788 (BNWL-486) PLUTONIUM ABSTRACTS. Volume 7, Number 5. Russell, Barbara G. (ed.) (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). May 31, 1967. Contract AT(45-1)-1830. 73p. Dep. CFSTI.

References (236) are given to reports and journals published from 1956 through May 1967. The categories covered include: biology and medicine; chemistry; health and safety; metallurgy and ceramics; physics; reactor technology; and miscellaneous. (P.C.H.)

35789 (COO-1112-118) A NEW EXPERIMENTAL TEST OF COULOMB'S LAW OF FORCE BETWEEN CHARGES. Cochran, Gary Don (Michigan Univ., Ann Arbor). 1967. Contract AT(11-1)-1112. 228p. Dep. CFSTI.

Thesis.

An investigation was made of the exponent in Coulomb's law of force between point charges. In 1936 S. J. Plimpton and W. E. Lawton established a value for this exponent of $2(1 \pm 10^{-9})$. The experiment performed by Plimpton and Lawton is analyzed and methods of refining the experiment are presented. Sophisticated voltage detection and data processing techniques are discussed which provide significant improvements in the experiment. The existence of spurious effects created difficulties in determining a new value for the exponent with the experiment. These spurious effects are discussed and their origins are investigated experimentally. Because of these effects two values are reported for the exponent. The first is $2(1 \pm 2.3 \times 10^{-11})$ which represents a "limit of error" for the experiment and the second is $2(1 \pm 4.6 \times 10^{-11})$ which represents our estimate of the "70% confidence interval." Results are applied to a recently reported discrepancy between experimental and theoretical values for the Lamb shift. It is shown that an exponent violation of Coulomb's law, within the experimental bounds now established, cannot account for this discrepancy. Theoretical calculations required for analysis of the experimental data also yield a new approximation to the charge distribution on a cubic conductor for the usual Coulomb inverse square law of force. The capacitance of a cube with side length $\underline{a}$ is obtained from the charge distribution and the result is 0.6596 $\underline{a}$ esu. (auth)

35790 (LA-3636) ARCHEOLOGICAL SALVAGE EXCAVATIONS ON THE MESITA DEL BUEY, LOS ALAMOS COUNTY, NEW MEXICO. Worman, Frederick C. V. (Los Alamos Scientific Lab., N. Mex.). Jan. 1967. Contract W-7405-eng-36. 39p. Dep. CFSTI.

Salvage archeological excavations from the portion of Los Alamos County, New Mexico, occupied by the Los Alamos Scientific Laboratory are reported. Excavation of four sites on the Mesita del Buey, including research procedures, and site descriptions, artifactual analysis, and the reconstruction of events in the area, are discussed. (auth)

35791 (LA-3704) FORTRAN BKW: A CODE FOR COMPUTING THE DETONATION PROPERTIES OF EXPLOSIVES. Mader, Charles L. (Los Alamos Scientific Lab., N. Mex.). May 1, 1967. Contract W-7405-eng-36. 47p. Dep. CFSTI.

A FORTRAN code for the CDC 6600 computer is described. The code computes the steady-state detonation properties of an explosive using the Becker-Kistiakowsky-Wilson equation of state. (auth)

35792 (LA-DC-8405) DETONATION THEORY AND EXPERIMENT. Davis, W. C.; Fickett, W. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 11p. (CONF-670914-3). Dep. CFSTI.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

Theoretical work on the detonation theory dealing with unsupported detonation in liquid and solid explosives and restricted to high-order detonation in which the reaction is nearly steady (independent of time in a reference frame moving with the front), and in which the detonation front is nearly plane is reviewed and compared, where possible to experimental results. It appears that the Chapman-Iouguet theory provides an adequate approximation since the adjustability of the equation of state parameters accommodates the defects in the flow theory. (F.S.)

35793 (LA-DC-8407) SHOCK-WAVE COMPRESSION OF POROUS MAGNESIUM AND AMMONIUM SULFATE. Johnson, J. O.; Wackerle, Jerry (Los Alamos Scientific Lab., N. Mex.). [1965]. Contract W-7405-eng-36. 5p. (CONF-670914-9). Dep. CFSTI.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

The streak-camera method is described which was employed to measure the velocities of shock waves in pressings of nonreactive magnesium and ammonium sulfate in defining the hydrodynamic states of shocked porous materials. Pressures and particle velocities for the shocked pressings were obtained and the mass conservation relation was used to compute densities in the shocked materials. (F.S.)

35794 (LA-DC-8408) SHOCK-WAVE EQUATION OF STATE FOR HIGH-DENSITY OXYGEN. Wackerle, Jerry; Seitz, W. L.; Jamieson, John C. (Los Alamos Scientific Lab., N. Mex.). [1966]. Contract W-7405-eng-36. 6p. (CONF-670914-5). Dep. CFSTI.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

High explosives were employed to produce planar single- and double-shock waves in liquid O initially at 76.9 ± 0.2°K. Free-run driving systems, liquid N coolant, and the photographic flash-gap technique (with Ar gas at reduced pressure in the gap) were used. Metal standards employed as cover plates included Mg alloy, dural, Cu and Au. Accurate determination of O shock parameters were complete dependent on precise representations of the Hugoniots and rarefaction isentropes of the metal standards. A thermodynamic equation-of-state was developed which was sufficiently general to be extended to lower temperatures as well as completing the thermodynamic description of the states experimentally attained. (F.S.)

35795 (LA-DC-8410) DETERMINATION OF NEW STANDARDS FOR SHOCK WAVE EQUATION-OF-STATE WORK. McQueen, R. G.; Marsh, S. P.; Carter, W. J. (Los Alamos Scientific Lab., N. Mex.). [1965]. Contract W-7405-eng-36. 12p. (CONF-670914-10). Dep. CFSTI.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

Three materials were investigated in establishing new shock wave standards. Aluminum alloy 921-T and aluminum 2024 representing low-shock-impedance material, deoxidized annealed Cu representing the intermediate range, and uranium alloy representing high-shock-impedance were investigated for use as standards for obtaining Hugoniot equation-of-state data by means of the shock-wave impedance match technique. (F.S.)

35796 (LA-DC-8814) DETONATION SPIN IN DRIVEN SHOCK WAVES IN A DILUTE EXOTHERMIC MIXTURE. Schott, Garry L. (Los Alamos Scientific Lab., N. Mex.). [1967]. Contract W-7405-eng-36. 6p. (CONF-670904-5). Dep. CFSTI.

From 154th National Meeting of the American Chemical Society, Chicago, Ill.

Occurrence of instabilities in shock waves in a mixture of 1% C_2H_2, 1.5% O_2, 97.5% Ar were studied. Conditions are identified where the phenomena exhibit the recognizable and quasi-reproducible form of single-headed spin. Experiments were conducted in a 10 cm ID circular brass shock tube. Brass shim stock or Mylar sheet diaphragms with H driver gas. A raster oscilloscope recorded the wave speeds. An attempt was made to relate some parameters of the observed single spinning waves to known properties of the chemical mixture. The single-headed spin which may be universally associated with unsupported detonations at the limits of their ability to propagate, is not exclusively a property of unsupported waves or of Chapman-Jouguet flow. (F.S.)

35797 (ORNL-4144) LIMIT THEOREMS FOR ADDITIVE-MULTIPLICATIVE RANDOM SEQUENCES. Paulson, A. S.; Uppuluri, V. R. R. (Oak Ridge National Lab., Tenn.). July 1967. Contract W-7405-eng-26. 83p. Dep. CFSTI.

Thesis. Submitted to Virginia Polytechnic Inst., Blacksburg.

The limiting behavior of the vector-valued, additive-multiplicative random sequences $\{\underline{Y}_n\}$ defined by the first order stochastic difference equation $\underline{Y}_n = \underline{W}_n + \underline{X}_n\underline{Y}_{n-1}$, where $\underline{W}_n$ is a random vector and $\underline{X}_n$ is a random matrix, is investigated. Conditions were provided which imply that the limiting moments of the vector $\underline{Y}_n$ exist.

General conditions which ensure that $\{Y_n\}$ converge in distribution are given. Theorems related to convergence in distribution of $\{Y_n\}$ are applicable to certain classes of functional equations and enables the deduction of certain properties of these functional equations. Convergence in probability of $\{Y_n\}$ is precluded except in trivial situations is proved. Conditions ensuring that the limiting moments of $\{Y_n\}$ are the moments of the limiting distribution of $\{Y_n\}$ are given. Necessary and sufficient conditions for the mutual independence among the components of the limiting random vector Y are provided. (auth)

35798 (ORNL-P-3103) FACTORS AFFECTING CELL INJURY IN CRYOSURGICAL FREEZING. Mazur, Peter (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 9p. (CONF-670529-1). Dep. CFSTI.

From Conference on Cryobiology and Cryosurgery, Buffalo, N. Y.

A discussion is presented on the physico-chemical factors underlying injury in single cells at sub-zero temperatures: effects of lowered temperature and events in single cells during ice formation and methods for maximizing the effectiveness of cryosurgical freezing. It was concluded that the likelihood of killing all cells in a target area could probably be increased by subjecting the target to two or more cycles of freezing (below –20°C) and slow thawing. (B.H.S.)

35799 (ORNL-TM-1250) A FORTRAN SUBROUTINE PACKAGE FOR LINEAR PROGRAMMING. Schneeberger, C.; Burrus, W. R.; Rust, B. (Oak Ridge National Lab., Tenn.). July 18, 1967 Contract W-7405-eng-26. 33p. Dep. CFSTI.

A FORTRAN program which uses the symmetric algorithm of J. Talacko was written for linear programming. It is compatible with FORTRAN II, IV, or FORTRAN 63 without any changes. The main program consists of two routines, TALAKO and DIFF. TALAKO performs the major linear programming computation, and DIFF is a subroutine used to carry out the elimination step efficiently, yet independently of the language. Several auxiliary routines make it easy to unscramble the transformation matrix, the solution, and the slacks. (auth)

35800 (ORNL-TM-1625) EFFECTS OF FAULTY RANDOM NUMBER GENERATORS ON MONTE CARLO CALCULATIONS. Feldman, Henry A. (Oak Ridge National Lab., Tenn.). July 12, 1967. Contract W-7405-eng-26. 67p. Dep. CFSTI.

Following Coveyou and MacPherson's estimations of serial correlation in certain uniform random-number generators, an attempt is made to find and measure the influence of this correlation on various random sampling algorithms, used in Monte Carlo calculations, which draw on a uniform generator. Theoretical results concerning some of these algorithms are presented, along with sketchy data on their response to faulty generators. (auth)

35801 (ORNL-TM-1778) A DIGITAL FILTERING TECHNIQUE FOR EFFICIENT FOURIER TRANSFORM CALCULATIONS. Ball, S. J. (Oak Ridge National Lab., Tenn.). July 12, 1967. Contract W-7405-eng-26. 20p. Dep. CFSTI.

A method for calculating Fourier transforms is presented which capitalizes on the similarity between the Fourier transform integral and the convolution integral. The method is implemented by an efficient digital computer code, which uses a digital simulation of a sine-cosine filter. Although this method is mathematically equivalent to a direct numerical calculation of the Fourier transform, it takes about one-third the time required for the direct integration. The code has been used extensively for calculating frequency response functions from pulse response test data and from cross- and auto-correlation functions. (auth)

35802 (ORO-3443-6) DISCRETE ANALOGS FOR MIXED BOUNDARY VALUE PROBLEMS OF ELLIPTIC TYPE. Technical Note BN-506. Thuraisamy, Vaithilingam (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Apr. 1967. Contract AT(40-1)-3443. 179p. Dep. CFSTI.

The approximate solutions of mixed boundary value problems for the Poisson's and Laplace's equations using finite difference methods are discussed. The precise formulation of these problems are given. Several finite difference analogs are considered and the rates of covergence of the approximate solutions to the actual solutions are investigated. (B.G.D.)

35803 (RFP-968) POLYNOMIAL CURVE FIT BY LEAST SQUARES. Clark, Harold E.; Coonfield, Donald C.; Jackson, Lynn E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). July 11, 1967. Contract AT(29-1)-1106. 10p. Dep. CFSTI.

To determine a polynomial approximation to a function by fitting experimentally determined data at a set of discrete points, a FORTRAN program was set up utilizing an IBM-360 and a CDC-3600 computer. The program, identified as LEAST, made use of the calculated polynomial to extrapolate the first zero of the function. A measure of fit is calculated and permits the application of three weighting options. (auth)

35804 (RISO-143) DIGITAL POSITIONING SYSTEM OF THE SLEWING AND INCHING TYPE. Neisig, K. E. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sept. 1966. 28p. Dep.

A control system is described for the digital setting of a mechanical shaft to a given position. The system uses a shaft digitizer and a step motor. To avoid dead zone inaccuracy the positioning takes place always from the same side and to avoid overshoot from inertia the last part of the motion takes place at low speed. (DENM)

35805 (RISO-149) GROWING BETA-BRASS SINGLE CRYSTALS. Als-Nielsen, J.; Kofoed, W. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar. 1967. 9p. Dep.

The apparatus for growing large single crystals by the Bridgman method is described, and the growth of beta-brass crystals is discussed in particular. Evaporation of Zn is avoided by encapsulating the graphite crucible in a stainless steel container, and with an appropriate growth rate of 7 mm/hr through a temperature gradient of 14°C/cm large perfect crystals (100 grams) were obtained from the melt. (auth)

35806 (SC-CR-67-2641) GENERAL SHELL EQUATIONS UNDER LARGE STRAINS AND ROTATIONS. Krieg, R. D.; Schreyer, H. L. (New Mexico Univ., Albuquerque. Bureau of Engineering Research). June 1967. Contract AT(29-1)-789; Subcontract 290-745. 140p. (ME-26). Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

Equations were derived for dynamic shells which are applicable to shells of inelastic materials which undergo large rotations and experience large strains. The Piola–Kirchhoff stress tensor of the second kind (Trefftz stress) together with the Lagrangian strain was used. Direct notation is used except for some work in curved rods. A surface deformation gradient similar to three-dimensional gradient of elasticity is used to express the strain field, the equations of motion, and relate generalized stresses and strains in terms of material and spatial quantities. (F.S.)

35807 (SC-DC-66-2447) FINE STRUCTURE OF COMPRESSIVE AND RELEASE WAVE SHAPES IN ALUMINUM MEASURED BY THE VELOCITY INTERFEROMETER TECHNIQUE. Barker, L. M. (Sandia Corp., Albuquerque, N. Mex.). May 1967. Contract AT(29-1)-789. 22p. (CONF-670914-1). DTIE.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

A new laser interferometer technique has been developed to measure the velocity history of a reflecting surface of a shock-loaded specimen. The velocity interferometer configuration overcomes the formerly reported distance interferometer limitation of being able to monitor only relatively small velocities. Some preliminary results are included on wave shapes in 6061-T6 aluminum shocked to various pressures up to 90-kbar. It was found, for example that the maximum strain rate in the plastic wave front increases from 0.13×10^6 sec^{-1} for a 20-kbar experiment to 1.5×10^6 sec^{-1} for a 37-kbar experiment. The shape of the elastic release wave is found to be considerably more smeared-out than expected, and computer analysis of the measured results indicates the influence of a strong Bauschinger effect on the unloading behavior of the aluminum. (auth)

35808 (SC-DC-67-1785) CALIBRATION OF SHOCK ACCELEROMETERS. Kelley, Ralph W. (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 29p. (CONF-670903-6). Dep. CFSTI.

From 22nd Instrument-Automation Conference and Exhibit, Chicago, Ill.

Although a wide variety of facilities and techniques have been used for shock calibration, the methods which are most widely used in calibration laboratories today fall into two general categories, the velocity change method and the impact-force method. These two methods are discussed together with some specific examples of shock calibration systems which utilize one of these basic methods. The following shock calibration systems are discussed: Drop-Ball Calibrator, Model 2965, manufactured by Endevco Corp; Ballistic Pendulum Shock Calibrator, developed by Sandia Laboratory, Albuquerque; Impact-Force Shock Calibrator, Model 894K, manufactured by Kistler Instrument Corp.; and Zatter Electromagnetic Shock Facility, developed by Sandia Laboratory, Livermore. The principle of operation of each calibrator is discussed together with the capabilities of each device. Typical calibration accuracy figures which can be expected on each calibrator are given. (auth)

35809 (SC-DC-67-1819) [SANDIA DESPUN ATTITUDE CONTROL SYSTEM]. Bossart, L. M. (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 10p. (CONF-670710-1). Dep. CFSTI.

From American Astronautical Society Symposium, Denver, Colo.

The despun attitude control system which completely removes the stabilizing spin developed during a rocket launch is presented. The stabilizing spin or roll rate is stopped by deploying fly-balls attached to the payload with steel cable wrapped around the payload. The attitude control dry nitrogen thrusters remove any residual roll rate and orient the payload in the desired attitude. (D.C.C.)

35810 (SC-DC-67-1910) SHOCK-WAVE STRESS GAUGE UTILIZING THE CAPACITANCE CHANGE OF A SOLID DIELECTRIC DISC. Graham, R. A.; Ingram, G. E. (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 15p. (CONF-670914-8). Dep. CFSTI.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

A new type of gage is described which is capable of measuring either particle velocity or stress with time resolution limited only by the rise time of the recording equipment and the planarity of the shock-wave front. The signal from the gage results from the capacitance change of a solid dielectric disc which produces a current which is instantaneously proportional to the velocity of the stressed electrode. (B.G.D.)

35811 (SC-DR-67-479) DEVELOPMENT OF MATHEMATICAL MODELS OF SEMICONDUCTOR DEVICES FOR COMPUTER-AIDED CIRCUIT ANALYSIS. Daniel, Marvin (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 48p. Dep. CFSTI.

The development and verification of mathematical models which will approximate the electrical characteristics of Zener and/or avalanche and tunnel diodes is presented. These models are compatible with, and designed to be used in, general computer circuit analysis programs. (auth)

35812 (SC-DR-67-499) COMPUTER PROGRAMMING FOR HOOP FILAMENT WINDING. Lachance, R. L. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 19p. Dep. CFSTI.

The techniques applied to compute gear ratios used in hoop winding are presented. Two programs were written to maintain a direct and uncomplicated approach. Specific application of this system was developed for the McClean–Anderson filament winder, but these procedures could be applied to any mechanical, gear-driven winder. (auth)

35813 (SC-RR-66-690) THE PITCH-DAMPING CHARACTERISTICS OF THE SANDIA TOMAHAWK ROCKET CONFIGURATION. Millard, W. A.; Stone, G. W. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 39p. Dep. CFSTI.

A free-oscillation dynamic testing apparatus suitable for obtaining large amplitude oscillatory data on a high fineness ratio wind tunnel model is described. The results of a dynamic stability test utilizing this apparatus in the Sandia Laboratory 18-inch Hypersonic Wind Tunnel with a model of the Tomahawk sounding rocket at a Mach number of 7.3 are presented. Correlation with theory is included. (auth)

35814 (SC-RR-67-510) COMPUTER IMPLEMENTATION OF THE MORSE LANGUAGE: A PROGRESS REPORT. Gilbert, E. J.; Morrison, D. R.; Weihe, J. W. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 59p. DTIE.

During the summer of 1966, Sandia Corporation sponsored a study group to investigate the feasibility of the computer implementation of the mathematical language of A. P. Morse. Initial objectives were to obtain programs which would read statements in this language, identify formulas, and categorize variables and constants. Further objectives included the checking of mathematical proofs. Some of the progress made in this effort is summarized. (auth)

35815 (SC-RR-67-525) AUTOMATIC THEOREM PROOF-CHECKING IN SET THEORY. A Preliminary Report. Bledsoe, W. W.; Gilbert, E. J. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 50p. Dep. CFSTI.

The research project on computer implementation of the Morse language, which was started at Sandia Corporation during the summer of 1966, has been continuing at Sandia Corporation and at the University of Texas in Austin. A preliminary report on the part of that activity which concerns the discovery of extended rules of inference valid in Morse's system and the writing of computer programs to check proofs using these rules is presented. (auth)

35816 (SC-TM-67-519) STABILITY OF MULTILAYERED ORTHOTROPIC CYLINDRICAL SHELLS SUBJECTED TO COMBINED AXIAL COMPRESSION AND LATERAL EXTERNAL PRESSURE. Priddy, T. G.; Hoagland, R. D.; MacDougall, H. R. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 48p. Dep. CFSTI.

The theory, computer program, and use conditions for the determination of the elastic stability of composite orthotropic cylinders subjected to combined radial and axial loading are described. (auth)

35817 (SC-TM-333-63(15)) SHOCK-WAVE CHARACTERISTICS IN HEAVILY LOADED DUSTY GAS. Ellett, D. M.; Banister, J. R. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1963. Contract AT(29-1)-789. 40p. Dep. CFSTI.

The Rankine–Hugoniot relations have been developed for a heavily loaded dusty gas and the temperatures, densities, and pressures are calculated for the region behind the shock and for the stagnation point under the two assumptions that the gas and dust come into equilibrium, and the gas and dust act as two independent systems. The stagnation lengths for the dust particles are also calculated. It is noted that the effective pressures at the stagnation point are little affected by the various assumptions. (auth)

35818 (SCL-DR-64-134) IMPROVED POWER-DRIVEN TUBE SYSTEM FOR PARACHUTE EJECTION. Rychnovsky, R. E. (Sandia Corp., Livermore, Calif.). Mar. 1965. Contract AT(29-1)-789. 33p. Dep. CFSTI.

Energy from an explosive gas generator was used to eject a 120-pound parachute pack (or a 120-pound weight simulating the parachute pack) at velocities up to 200 feet per second. The moving tube was retained with the tube assembly and the gas seal was effective during and after the ejection stroke. Analysis of the system and results of the 17 tests performed in the development of this parachute ejection system are described. (auth)

35819 (SCL-DR-67-48) PNEUMATIC HAMMER DEVELOPMENT. Thompson, R. A. (Sandia Corp., Livermore, Calif.). July 1967. Contract AT(29-1)-789. 29p. Dep. CFSTI.

A gas gun has been developed for low stress level (1 to 20 kilobars) impact studies. The projectile face and impact surface are designed so that a planar impact is obtained with an accompanying fast stress-wave rise time. The projectile velocity is measured just before impact. The projectile velocity is measured just before impact. The simplicity of operation provides the capability of many tests per day. (auth)

35820 (TID-3741) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period, April–June 1967. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 16p. Dep. DTIE Free.

A bibliography containing the descriptive cataloging, which includes titles, authors, availability, publication dates, prices, and report numbers, of 108 bibliographies either issued or in preparation is presented. A report number index is also included. (B.G.D.)

35821 (UCRL-11216) STATISTICAL THERMODYNAMICS OF PARTICULATE FLUIDIZATION. Saxton, James A. Jr.; Vermeulen, Theodore (California Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1966. Contract W-7405-eng-48. 203p. Dep. CFSTI.

Thesis. Submitted by James A. Saxton Jr.

A statistical-thermodynamic theory of fluidization has been postulated, and an experimental assessment of its validity made. A literature survey of liquid theory and fluidization properties led to the choice of the smoothed-potential cell model of liquids for use in interpreting fluidization phenomena. Experimental measurements were made of expansion, viscosity, miscibility, and surface-tension behavior in water-fluidized glass-sphere systems. Both rotating-spindle and moving-sphere viscosity measurements were made. Agreement between the results of the two techniques was found to be quite good. The data were analyzed in terms of our cell model using the hard-sphere viscosity expression of Collins and Raffel. By this analysis, the fluidized-bed parameter equivalent to thermodynamic temperature was found to be a function of fluid properties, and to be proportional to the square of the fluidizing velocity. A $\frac{3}{4}$-inch-diameter sampling tube was utilized for the investigation of miscibility in two-phase beds. Sampling confirmed the visually observed interface, and indicated uniformity of concentration within each phase. The mutual solubility of different-diameter particles was found to diminish with increasing fluidizing velocity. Cell-model analysis could be extended to two-phase systems due to the lack of dependence upon particle properties of the "nominal-temperature" function. Results that lay within an order of magnitude of experimental observation were achieved. Measurements were made by visual observation of waves created

at the interface by a dropping cylinder. From the surface-wave data, the particle free volume at the surface was found to be less than in the bulk phase. (auth)

35822 (UCRL-17128) REFLECTION OF POLARIZED LIGHT FROM FILM-COVERED SURFACES. Mowat, J. Richard; Muller, Rolf H. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1967. Contract W-7405-eng-48. 70p. Dep. CFSTI.

Exact equations are derived which relate the (complex) index of refraction and the thickness of a single, absorbing or transparent film on an absorbing or transparent substrate to the changes sustained by polarized light reflected by the film-covered surface. Both film and substrate are assumed to be linear, homogeneous, and isotropic media. (auth)

35823 (UCRL-50270) THE QUANTITATIVE NATURE OF THE RELATIONSHIP OF CORONARY ARTERY ATHEROSCLEROSIS AND CORONARY HEART DISEASE RISK. Gofman, John W. (California Univ., Livermore. Lawrence Radiation Lab.). May 1967. Contract W-7405-eng-48. 19p. Dep. CFSTI.

Quantitative considerations of the nature of the relationship of coronary heart disease (CHD) risk and degree of coronary artery atherosclerosis are reported. The methodology for determination of CHD risk from distributions of atherosclerosis in population groups and their respective CHD cases is presented in detail. The calculation of expected distribution of CHD cases is the inverse, if risk and base population distribution are available. Neither a linear rise in risk with increase in degree of atherosclerosis nor a more rapid than linear rise in risk is consistent with the observation concerning CHD. A sigmoid type of risk curve, with CHD risk rising rapidly at a particular degree of coronary atherosclerosis does explain the observations of Strong and his collaborators that CHD cases show comparable degrees of atherosclerosis even though they arise from base population groups differing widely in average degree of atherosclerosis. The implication for prophylaxis is that a marked drop in CHD risk and incidence might be achieved if degree of coronary atherosclerosis is kept to values just below the steeply rising portion of the CHD risk curve. (auth)

35824 (UCRL-50284) APPROACH TO THE STUDY OF LIGHT ARMOR. Wilkins, Mark; Honodel, Charles; Sawle, David (California Univ., Livermore. Lawrence Radiation Lab.). June 13, 1967. Contract W-7405-eng-48. 43p. Dep. CFSTI.

The first step in a program to obtain a fundamental understanding of the relationship that properties of materials have on the effectiveness of light armor is presented. Two experimental diagnostic approaches have been used—highspeed cameras and 600 kV flash x rays. Theoretical models of material behavior have been incorporated into a two-dimensional elastic-plastic computer program. Examples of projectile penetration are given for sharp- and blunt-nosed projectiles. (auth)

35825 (UCRL-70444) THE HEAT AND PRODUCTS OF DETONATION OF CYCLOTETRAMETHYLENE TETRANITRAMINE (HMX), 2,4,6-TRINITROTOLUENE (TNT), NITROMETHANE (NM), AND BIS[2,2-DINITRO-2-FLUORO-ETHYL]-FORMAL (FEFO). Ornellas, Donald L. (California Univ., Livermore. Lawrence Radiation Lab.). May 22, 1967. Contract W-7405-eng-48. 7p. (CONF-670904-4). Dep. CFSTI.

From 154th National Meeting of the American Chemical Society, Chicago, Ill.

Calorimetric measurements combined with product analysis were used to obtain fundamental information about the detonation process. The charges were completely confined by a 1.27-cm thickness of gold. The products and heats of detonation for HMX, TNT, NM, and FEFO from heavily confined charges are listed. The products represent those found on the Chapman-Jouguet isentrope at temperatures in the range 1500 to 1800°K. Proceeding down the scale of oxygen balance the proportion of carbon appearing as solid carbon increased and that appearing as carbon dioxide decreased. The proportion of hydrogen appearing as hydrogen gas increased and that appearing as water decreased. NM, a low-density explosive with a high hydrogen-to-carbon ratio, was the exception to the trends. NM has the same oxygen balance as TNT yet proportionally more carbon appeared as carbon monoxide and less as solid carbon that might be expected from the TNT results. Greater amounts of methane were present in NM products than for any of the other explosives. All of the fluorine in FEFO appeared as hydrofluoric acid. Unconfined charges of HMX and TNT were fired and the products compared favorably to calculated equilibrium products at constant volume. The TNT data indicated that solid carbon equilibrates rapidly during the reshocking of products that occur with unconfined charges. (D.H.M.)

35826 (UCRL-70498) METABOLIC CORRELATIONS WITH HYPERLIPIDEMIA. Hatch, Frederick T. (California Univ., Livermore. Lawrence Radiation Lab.). June 6, 1967. Contract W-7405-eng-48. 10p. (CONF-670212-1). Dep. CFSTI.

From Deuel Conference on the Fate of Dietary Lipids, Carmel, Calif.

Analysis of data from metabolic studies on patients with a marked degree of carbohydrate-induced hyperlipidemia indicated a significant correlation between relative weight and lipid parameters. These correlations also suggest that overnutrition may play an important role in producing the biochemical findings associated with the premature development of coronary heart disease. (C.H.)

35827 (UCRL-70518) USE OF CRYSTAL ACCELEROMETERS AT HIGH ACCELERATIONS AND TEMPERATURES. Larder, Richard A. (California Univ., Livermore. Lawrence Radiation Lab.). June 16, 1967. Contract W-7405-eng-48. 10p. (CONF-670903-8). Dep. CFSTI.

From 22nd Instrument-Automation Conference and Exhibit, Chicago, Ill.

The effect of temperature on the zero shift of piezoelectric accelerometers under shock loading was investigated with the Hopkinson bar technique. The accelerometers tested were subjected to temperatures as high as 500°F, and to accelerations as high as 5000 g. Zero shifts of up to 100% were obtained. The cause of zero shift is believed to be the differential thermal expansion and the lateral relief of thermal stress that occur during mechanical loading. However, if accelerometers are preconditioned (shocked) at the test temperatures, the zero-shift problem is eliminated. (auth)

35828 (WAPD-TM-692) ELLIPTIC DIFFERENCE EQUATIONS ON A CONVEX DOMAIN. Guilinger, W. H. Jr.; Kellogg, R. B. (Bettis Atomic Power Lab., Pittsburgh, Pa.). July 1967. Contract AT(11-1)-Gen-14. 26p. Dep. CFSTI.

An elliptic partial differential equation is considered in a convex domain with Dirichlet boundary conditions. For a particular finite difference approximation of the problem in two dimensions, it is shown that the maximum component norm of the discretization error is bounded by a constant times the square root of the mesh spacing. The constant depends on properties of the domain and bounds on third derivatives of the solution. (auth)

35829 (WAPD-TM-710) THE FINK/PANTRY DATA STORAGE AND RETRIEVAL SYSTEM FOR A COMPUTER. Bohl, H. Jr.; Marlowe, O. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.). May 1967. Contract AT(11-1)-Gen-14. 34p. Dep. CFSTI.

The FINK/PANTRY subroutines use a forward linked list structure in main storage to store and retrieve data. The data are stored in variable length blocks. Each chain in the list is assigned an identifier as is each block of data entered in the chain. The data are retrieved by using the two identifiers. Overflow of main storage to auxiliary storage is handled in a similar manner where the block of data moved to and from auxiliary storage is an entire chain. These blocks are also linked together in chains. The main storage structure is also used to provide dynamic allocation. (auth)

35830 (Y-1585) SOME AOQ AND AFI VALUES FOR THE DODGE AND TORREY CSP-3 CONTINUOUS SAMPLING PLAN. Hull, R. H. Jr. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). July 7, 1967. Contract W-7405-eng-26. 176p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The purposes of this study were to present a mathematical proof of the AOQ formula for the continuous sampling plan, CSP-3, and to apply this formula in deriving AOQ and AFI values for CSP-3. Because of the complexity of the AOQ formula and time consuming calculations involved, a computer program was written in Fortran IV language for the IBM 7090 computer in order to determine AOQ and AFI values. For each set of values generated, the per cent defective, p, ranged from 0.5 per cent to 50.0 per cent at increments of 0.5 per cent. The values of i used in this study ranged from 5 to 200 units, and the sampling rate, f, began with 5 per cent and terminated with 50 per cent at increments of 5 per cent. An assumption was made that i = k. The computer program was written in such a manner that AOQ and AFI values could be generated for a given i value at various levels of f and p with only one data card. Therefore, AOQ and AFI values other than those appearing in this study may be generated with this computer program. Curves for obtaining values of f and i for a given value of AOQL were determined. When compared to the corresponding CSP-2 values, an examination revealed that the i values for CSP-3 were reduced by about 4 units when AOQL is 2 per cent; at 3 per cent AOQL, the CSP-3 i values were about 3 units less than the CSP-2 values; and for AOQL values greater than 3 per cent, the i values for CSP-3 were about 2 units less than the CSP-2 values. (auth)

35831 (LA-tr-67-49) THERMAL CONDUCTIVITY OF HELIUM AT TEMPERATURES FROM 273.65 TO 21.15°K AND PRESSURES FROM 0.101 TO 49.14 Mnewtons/M². Golubev, I. F.; Shpagina, I. B. Translated by J. Kerrisk (Los Alamos Scientific Lab., N. Mex.), from Gazov. Prom., 11: No. 8, 40-2(Aug. 1966). 6p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Measurements of the thermal conductivity of helium at temperatures from 273.65 to 21.15°K and pressures from 0.101 to 49.14 × 10^6 newtons/meter² (from 0 to 500 kgm/cm² gage pressure) were conducted by the method of regular heat regime in an apparatus using a modified double calorimeter. The outer cylinder of the double calorimeter was copper. The inner cylinder for measurements in the range of 273.65 to 78.15°K was also copper, and for measurements in the range 78.15 to 21.15°K was lead, since the heat capacity of lead is greater than the heat capacity of copper at these temperatures. This arrangement gave sufficient duration of cooling which allowed the determination of the thermal conductivity of helium by the regular regime method. (auth)

35832 I-CAN; International-Chromosome Analysis Newsletter, No. 1. Neurath, Peter W. (ed.) Vienna, International Atomic Energy Agency [1967]. 14p. IAEA.

International-Chromosome Analysis Newsletter (I-CAN) is prepared for the use of those engaged in computer-aided chromosome analysis. A report on the activities and discussions of a study group that met to consider the current status of the automation of karyotype analysis and a suggested list of pertinent references (19) are also included. (B.H.S.)

General conditions which ensure that $\{Y_n\}$ converge in distribution are given. Theorems related to convergence in distribution of $\{Y_n\}$ are applicable to certain classes of functional equations and enables the deduction of certain properties of these functional equations. Convergence in probability of $\{Y_n\}$ is precluded except in trivial situations is proved. Conditions ensuring that the limiting moments of $\{Y_n\}$ are the moments of the limiting distribution of $\{Y_n\}$ are given. Necessary and sufficient conditions for the mutual independence among the components of the limiting random vector Y are provided. (auth)

35798 (ORNL-P-3103) FACTORS AFFECTING CELL INJURY IN CRYOSURGICAL FREEZING. Mazur, Peter (Oak Ridge National Lab., Tenn.). [1967]. Contract W-7405-eng-26. 9p. (CONF-670529-1). Dep. CFSTI.

From Conference on Cryobiology and Cryosurgery, Buffalo, N. Y.

A discussion is presented on the physico-chemical factors underlying injury in single cells at sub-zero temperatures: effects of lowered temperature and events in single cells during ice formation and methods for maximizing the effectiveness of cryosurgical freezing. It was concluded that the likelihood of killing all cells in a target area could probably be increased by subjecting the target to two or more cycles of freezing (below -20°C) and slow thawing. (B.H.S.)

35799 (ORNL-TM-1250) A FORTRAN SUBROUTINE PACKAGE FOR LINEAR PROGRAMMING. Schneeberger, C.; Burrus, W. R.; Rust, B. (Oak Ridge National Lab., Tenn.). July 18, 1967 Contract W-7405-eng-26. 33p. Dep. CFSTI.

A FORTRAN program which uses the symmetric algorithm of J. Talacko was written for linear programming. It is compatible with FORTRAN II, IV, or FORTRAN 63 without any changes. The main program consists of two routines, TALAKO and DIFF. TALAKO performs the major linear programming computation, and DIFF is a subroutine used to carry out the elimination step efficiently, yet independently of the language. Several auxiliary routines make it easy to unscramble the transformation matrix, the solution, and the slacks. (auth)

35800 (ORNL-TM-1625) EFFECTS OF FAULTY RANDOM NUMBER GENERATORS ON MONTE CARLO CALCULATIONS. Feldman, Henry A. (Oak Ridge National Lab., Tenn.). July 12, 1967. Contract W-7405-eng-26. 67p. Dep. CFSTI.

Following Coveyou and MacPherson's estimations of serial correlation in certain uniform random-number generators, an attempt is made to find and measure the influence of this correlation on various random sampling algorithms, used in Monte Carlo calculations, which draw on a uniform generator. Theoretical results concerning some of these algorithms are presented, along with sketchy data on their response to faulty generators. (auth)

35801 (ORNL-TM-1778) A DIGITAL FILTERING TECHNIQUE FOR EFFICIENT FOURIER TRANSFORM CALCULATIONS. Ball, S. J. (Oak Ridge National Lab., Tenn.). July 12, 1967. Contract W-7405-eng-26. 20p. Dep. CFSTI.

A method for calculating Fourier transforms is presented which capitalizes on the similarity between the Fourier transform integral and the convolution integral. The method is implemented by an efficient digital computer code, which uses a digital simulation of a sine-cosine filter. Although this method is mathematically equivalent to a direct numerical calculation of the Fourier transform, it takes about one-third the time required for the direct integration. The code has been used extensively for calculating frequency response functions from pulse response test data and from cross- and auto-correlation functions. (auth)

35802 (ORO-3443-6) DISCRETE ANALOGS FOR MIXED BOUNDARY VALUE PROBLEMS OF ELLIPTIC TYPE. Technical Note BN-506. Thuraisamy, Vaithilingam (Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). Apr. 1967. Contract AT(40-1)-3443. 179p. Dep. CFSTI.

The approximate solutions of mixed boundary value problems for the Poisson's and Laplace's equations using finite difference methods are discussed. The precise formulation of these problems are given. Several finite difference analogs are considered and the rates of covergence of the approximate solutions to the actual solutions are investigated. (B.G.D.)

35803 (RFP-968) POLYNOMIAL CURVE FIT BY LEAST SQUARES. Clark, Harold E.; Coonfield, Donald C.; Jackson, Lynn E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). July 11, 1967. Contract AT(29-1)-1106. 10p. Dep. CFSTI.

To determine a polynomial approximation to a function by fitting experimentally determined data at a set of discrete points, a FORTRAN program was set up utilizing an IBM-360 and a CDC-3600 computer. The program, identified as LEAST, made use of the calculated polynomial to extrapolate the first zero of the function. A measure of fit is calculated and permits the application of three weighting options. (auth)

35804 (RISO-143) DIGITAL POSITIONING SYSTEM OF THE SLEWING AND INCHING TYPE. Neisig, K. E. (Danish Atomic Energy Commission, Risoe. Research Establishment). Sept. 1966. 28p. Dep.

A control system is described for the digital setting of a mechanical shaft to a given position. The system uses a shaft digitizer and a step motor. To avoid dead zone inaccuracy the positioning takes place always from the same side and to avoid overshoot from inertia the last part of the motion takes place at low speed. (DENM)

35805 (RISO-149) GROWING BETA-BRASS SINGLE CRYSTALS. Als-Nielsen, J.; Kofoed, W. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar. 1967. 9p. Dep.

The apparatus for growing large single crystals by the Bridgman method is described, and the growth of beta-brass crystals is discussed in particular. Evaporation of Zn is avoided by encapsulating the graphite crucible in a stainless steel container, and with an appropriate growth rate of 7 mm/hr through a temperature gradient of 14°C/cm large perfect crystals (100 grams) were obtained from the melt. (auth)

35806 (SC-CR-67-2641) GENERAL SHELL EQUATIONS UNDER LARGE STRAINS AND ROTATIONS. Krieg, R. D.; Schreyer, H. L. (New Mexico Univ., Albuquerque. Bureau of Engineering Research). June 1967. Contract AT(29-1)-789; Subcontract 290-745. 140p. (ME-26). Dep. CFSTI.

For Sandia Corp., Albuquerque, N. Mex.

Equations were derived for dynamic shells which are applicable to shells of inelastic materials which undergo large rotations and experience large strains. The Piola-Kirchhoff stress tensor of the second kind (Trefftz stress) together with the Lagrangian strain was used. Direct notation is used except for some work in curved rods. A surface deformation gradient similar to three-dimensional gradient of elasticity is used to express the strain field, the equations of motion, and relate generalized stresses and strains in terms of material and spatial quantities. (F.S.)

35807 (SC-DC-66-2447) FINE STRUCTURE OF COMPRESSIVE AND RELEASE WAVE SHAPES IN ALUMINUM MEASURED BY THE VELOCITY INTERFEROMETER TECHNIQUE. Barker, L. M. (Sandia Corp., Albuquerque, N. Mex.). May 1967. Contract AT(29-1)-789. 22p. (CONF-670914-1). DTIE.

From International Symposium on the Behavior of Dense Media Under High Impulsive Pressures, Paris, France.

A new laser interferometer technique has been developed to measure the velocity history of a reflecting surface of a shock-loaded specimen. The velocity interferometer configuration overcomes the formerly reported distance interferometer limitation of being able to monitor only relatively small velocities. Some preliminary results are included on wave shapes in 6061-T6 aluminum shocked to various pressures up to 90-kbar. It was found, for example that the maximum strain rate in the plastic wave front increases from 0.13×10^6 sec^{-1} for a 20-kbar experiment to 1.5×10^6 sec^{-1} for a 37-kbar experiment. The shape of the elastic release wave is found to be considerably more smeared-out than expected, and computer analysis of the measured results indicates the influence of a strong Bauschinger effect on the unloading behavior of the aluminum. (auth)

35808 (SC-DC-67-1785) CALIBRATION OF SHOCK ACCELEROMETERS. Kelley, Ralph W. (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 29p. (CONF-670903-6). Dep. CFSTI.

From 22nd Instrument-Automation Conference and Exhibit, Chicago, Ill.

Although a wide variety of facilities and techniques have been used for shock calibration, the methods which are most widely used in calibration laboratories today fall into two general categories, the velocity change method and the impact-force method. These two methods are discussed together with some specific examples of shock calibration systems which utilize one of these basic methods. The following shock calibration systems are discussed: Drop-Ball Calibrator, Model 2965, manufactured by Endevco Corp; Ballistic Pendulum Shock Calibrator, developed by Sandia Laboratory, Albuquerque; Impact-Force Shock Calibrator, Model 894K, manufactured by Kistler Instrument Corp.; and Zatter Electromagnetic Shock Facility, developed by Sandia Laboratory, Livermore. The principle of operation of each calibrator is discussed together with the capabilities of each device. Typical calibration accuracy figures which can be expected on each calibrator are given. (auth)

35809 (SC-DC-67-1819) [SANDIA DESPUN ATTITUDE CONTROL SYSTEM]. Bossart, L. M. (Sandia Corp., Albuquerque, N. Mex.). June 1967. Contract AT(29-1)-789. 10p. (CONF-670710-1). Dep. CFSTI.

From American Astronautical Society Symposium, Denver, Colo.

The despun attitude control system which completely removes the stabilizing spin developed during a rocket launch is presented. The stabilizing spin or roll rate is stopped by deploying fly-balls attached to the payload with steel cable wrapped around the payload. The attitude control dry nitrogen thrusters remove any residual roll rate and orient the payload in the desired attitude. (D.C.C.)

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A free-oscillation dynamic testing apparatus suitable for obtaining large amplitude oscillatory data on a high fineness ratio wind tunnel model is described. The results of a dynamic stability test utilizing this apparatus in the Sandia Laboratory 18-inch Hypersonic Wind Tunnel with a model of the Tomahawk sounding rocket at a Mach number of 7.3 are presented. Correlation with theory is included. (auth)

35814 (SC-RR-67-510) COMPUTER IMPLEMENTATION OF THE MORSE LANGUAGE: A PROGRESS REPORT. Gilbert, E. J.; Morrison, D. R.; Weihe, J. W. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 59p. DTIE.

During the summer of 1966, Sandia Corporation sponsored a study group to investigate the feasibility of the computer implementation of the mathematical language of A. P. Morse. Initial objectives were to obtain programs which would read statements in this language, identify formulas, and categorize variables and constants. Further objectives included the checking of mathematical proofs. Some of the progress made in this effort is summarized. (auth)

35815 (SC-RR-67-525) AUTOMATIC THEOREM PROOF-CHECKING IN SET THEORY. A Preliminary Report. Bledsoe, W. W.; Gilbert, E. J. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 50p. Dep. CFSTI.

The research project on computer implementation of the Morse language, which was started at Sandia Corporation during the summer of 1966, has been continuing at Sandia Corporation and at the University of Texas in Austin. A preliminary report on the part of that activity which concerns the discovery of extended rules of inference valid in Morse's system and the writing of computer programs to check proofs using these rules is presented. (auth)

35816 (SC-TM-67-519) STABILITY OF MULTILAYERED ORTHOTROPIC CYLINDRICAL SHELLS SUBJECTED TO COMBINED AXIAL COMPRESSION AND LATERAL EXTERNAL PRESSURE. Priddy, T. G.; Hoagland, R. D.; MacDougall, H. R. (Sandia Corp., Albuquerque, N. Mex.). July 1967. Contract AT(29-1)-789. 48p. Dep. CFSTI.

The theory, computer program, and use conditions for the determination of the elastic stability of composite orthotropic cylinders subjected to combined radial and axial loading are described. (auth)

35817 (SC-TM-333-63(15)) SHOCK-WAVE CHARACTERISTICS IN HEAVILY LOADED DUSTY GAS. Ellett, D. M.; Banister, J. R. (Sandia Corp., Albuquerque, N. Mex.). Dec. 1963. Contract AT(29-1)-789. 40p. Dep. CFSTI.

The Rankine–Hugoniot relations have been developed for a heavily loaded dusty gas and the temperatures, densities, and pressures are calculated for the region behind the shock and for the stagnation point under the two assumptions that the gas and dust come into equilibrium, and the gas and dust act as two independent systems. The stagnation lengths for the dust particles are also calculated. It is noted that the effective pressures at the stagnation point are little affected by the various assumptions. (auth)

35818 (SCL-DR-64-134) IMPROVED POWER-DRIVEN TUBE SYSTEM FOR PARACHUTE EJECTION. Rychnovsky, R. E. (Sandia Corp., Livermore, Calif.). Mar. 1965. Contract AT(29-1)-789. 33p. Dep. CFSTI.

Energy from an explosive gas generator was used to eject a 120-pound parachute pack (or a 120-pound weight simulating the parachute pack) at velocities up to 200 feet per second. The moving tube was retained with the tube assembly and the gas seal was effective during and after the ejection stroke. Analysis of the system and results of the 17 tests performed in the development of this parachute ejection system are described. (auth)

35819 (SCL-DR-67-48) PNEUMATIC HAMMER DEVELOPMENT. Thompson, R. A. (Sandia Corp., Livermore, Calif.). July 1967. Contract AT(29-1)-789. 29p. Dep. CFSTI.

A gas gun has been developed for low stress level (1 to 20 kilobars) impact studies. The projectile face and impact surface are designed so that a planar impact is obtained with an accompanying fast stress-wave rise time. The projectile velocity is measured just before impact. The projectile velocity is measured just before impact. The simplicity of operation provides the capability of many tests per day. (auth)

35820 (TID-3741) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Issued or in Progress During the Period, April–June 1967. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn.). 16p. Dep. DTIE Free.

A bibliography containing the descriptive cataloging, which includes titles, authors, availability, publication dates, prices, and report numbers, of 108 bibliographies either issued or in preparation is presented. A report number index is also included. (B.G.D.)

35821 (UCRL-11216) STATISTICAL THERMODYNAMICS OF PARTICULATE FLUIDIZATION. Saxton, James A. Jr.; Vermeulen, Theodore (California Univ., Berkeley. Lawrence Radiation Lab.). Dec. 1966. Contract W-7405-eng-48. 203p. Dep. CFSTI.

Thesis. Submitted by James A. Saxton Jr.

A statistical-thermodynamic theory of fluidization has been postulated, and an experimental assessment of its validity made. A literature survey of liquid theory and fluidization properties led to the choice of the smoothed-potential cell model of liquids for use in interpreting fluidization phenomena. Experimental measurements were made of expansion, viscosity, miscibility, and surface-tension behavior in water-fluidized glass-sphere systems. Both rotating-spindle and moving-sphere viscosity measurements were made. Agreement between the results of the two techniques was found to be quite good. The data were analyzed in terms of our cell model using the hard-sphere viscosity expression of Collins and Raffel. By this analysis, the fluidized-bed parameter equivalent to thermodynamic temperature was found to be a function of fluid properties, and to be proportional to the square of the fluidizing velocity. A $\frac{3}{4}$-inch-diameter sampling tube was utilized for the investigation of miscibility in two-phase beds. Sampling confirmed the visually observed interface, and indicated uniformity of concentration within each phase. The mutual solubility of different-diameter particles was found to diminish with increasing fluidizing velocity. Cell-model analysis could be extended to two-phase systems due to the lack of dependence upon particle properties of the "nominal-temperature" function. Results that lay within an order of magnitude of experimental observation were achieved. Measurements were made by visual observation of waves created

at the interface by a dropping cylinder. From the surface-wave data, the particle free volume at the surface was found to be less than in the bulk phase. (auth)

35822 (UCRL-17128) REFLECTION OF POLARIZED LIGHT FROM FILM-COVERED SURFACES. Mowat, J. Richard; Muller, Rolf H. (California Univ., Berkeley. Lawrence Radiation Lab.). Feb. 1967. Contract W-7405-eng-48. 70p. Dep. CFSTI.

Exact equations are derived which relate the (complex) index of refraction and the thickness of a single, absorbing or transparent film on an absorbing or transparent substrate to the changes sustained by polarized light reflected by the film-covered surface. Both film and substrate are assumed to be linear, homogeneous, and isotropic media. (auth)

35823 (UCRL-50270) THE QUANTITATIVE NATURE OF THE RELATIONSHIP OF CORONARY ARTERY ATHEROSCLEROSIS AND CORONARY HEART DISEASE RISK. Gofman, John W. (California Univ., Livermore. Lawrence Radiation Lab.). May 1967. Contract W-7405-eng-48. 19p. Dep. CFSTI.

Quantitative considerations of the nature of the relationship of coronary heart disease (CHD) risk and degree of coronary artery atherosclerosis are reported. The methodology for determination of CHD risk from distributions of atherosclerosis in population groups and their respective CHD cases is presented in detail. The calculation of expected distribution of CHD cases is the inverse, if risk and base population distribution are available. Neither a linear rise in risk with increase in degree of atherosclerosis nor a more rapid than linear rise in risk is consistent with the observation concerning CHD. A sigmoid type of risk curve, with CHD risk rising rapidly at a particular degree of coronary atherosclerosis does explain the observations of Strong and his collaborators that CHD cases show comparable degrees of atherosclerosis even though they arise from base population groups differing widely in average degree of atherosclerosis. The implication for prophylaxis is that a marked drop in CHD risk and incidence might be achieved if degree of coronary atherosclerosis is kept to values just below the steeply rising portion of the CHD risk curve. (auth)

35824 (UCRL-50284) APPROACH TO THE STUDY OF LIGHT ARMOR. Wilkins, Mark; Honodel, Charles; Sawle, David (California Univ., Livermore. Lawrence Radiation Lab.). June 13, 1967. Contract W-7405-eng-48. 43p. Dep. CFSTI.

The first step in a program to obtain a fundamental understanding of the relationship that properties of materials have on the effectiveness of light armor is presented. Two experimental diagnostic approaches have been used—highspeed cameras and 600 kV flash x rays. Theoretical models of material behavior have been incorporated into a two-dimensional elastic-plastic computer program. Examples of projectile penetration are given for sharp- and blunt-nosed projectiles. (auth)

35825 (UCRL-70444) THE HEAT AND PRODUCTS OF DETONATION OF CYCLOTETRAMETHYLENE TETRANITRAMINE (HMX), 2,4,6-TRINITROTOLUENE (TNT), NITROMETHANE (NM), AND BIS[2,2-DINITRO-2-FLUORO-ETHYL]-FORMAL (FEFO). Ornellas, Donald L. (California Univ., Livermore. Lawrence Radiation Lab.). May 22, 1967. Contract W-7405-eng-48. 7p. (CONF-670904-4). Dep. CFSTI.

From 154th National Meeting of the American Chemical Society, Chicago, Ill.

Calorimetric measurements combined with product analysis were used to obtain fundamental information about the detonation process. The charges were completely confined by a 1.27-cm thickness of gold. The products and heats of detonation for HMX, TNT, NM, and FEFO from heavily confined charges are listed. The products represent those found on the Chapman-Jouguet isentrope at temperatures in the range 1500 to 1800°K. Proceeding down the scale of oxygen balance the proportion of carbon appearing as solid carbon increased and that appearing as carbon dioxide decreased. The proportion of hydrogen appearing as hydrogen gas increased and that appearing as water decreased. NM, a low-density explosive with a high hydrogen-to-carbon ratio, was the exception to the trends. NM has the same oxygen balance as TNT yet proportionally more carbon appeared as carbon monoxide and less as solid carbon that might be expected from the TNT results. Greater amounts of methane were present in NM products than for any of the other explosives. All of the fluorine in FEFO appeared as hydrofluoric acid. Unconfined charges of HMX and TNT were fired and the products compared favorably to calculated equilibrium products at constant volume. The TNT data indicated that solid carbon equilibrates rapidly during the reshocking of products that occur with unconfined charges. (D.H.M.)

35826 (UCRL-70498) METABOLIC CORRELATIONS WITH HYPERLIPIDEMIA. Hatch, Frederick T. (California Univ., Livermore. Lawrence Radiation Lab.). June 6, 1967. Contract W-7405-eng-48. 10p. (CONF-670212-1). Dep. CFSTI.

From Deuel Conference on the Fate of Dietary Lipids, Carmel, Calif.

Analysis of data from metabolic studies on patients with a marked degree of carbohydrate-induced hyperlipidemia indicated a significant correlation between relative weight and lipid parameters. These correlations also suggest that overnutrition may play an important role in producing the biochemical findings associated with the premature development of coronary heart disease. (C.H.)

35827 (UCRL-70518) USE OF CRYSTAL ACCELEROMETERS AT HIGH ACCELERATIONS AND TEMPERATURES. Larder, Richard A. (California Univ., Livermore. Lawrence Radiation Lab.). June 16, 1967. Contract W-7405-eng-48. 10p. (CONF-670903-8). Dep. CFSTI.

From 22nd Instrument-Automation Conference and Exhibit, Chicago, Ill.

The effect of temperature on the zero shift of piezoelectric accelerometers under shock loading was investigated with the Hopkinson bar technique. The accelerometers tested were subjected to temperatures as high as 500°F, and to accelerations as high as 5000 g. Zero shifts of up to 100% were obtained. The cause of zero shift is believed to be the differential thermal expansion and the lateral relief of thermal stress that occur during mechanical loading. However, if accelerometers are preconditioned (shocked) at the test temperatures, the zero-shift problem is eliminated. (auth)

35828 (WAPD-TM-692) ELLIPTIC DIFFERENCE EQUATIONS ON A CONVEX DOMAIN. Guilinger, W. H. Jr.; Kellogg, R. B. (Bettis Atomic Power Lab., Pittsburgh, Pa.). July 1967. Contract AT(11-1)-Gen-14. 26p. Dep. CFSTI.

An elliptic partial differential equation is considered in a convex domain with Dirichlet boundary conditions. For a particular finite difference approximation of the problem in two dimensions, it is shown that the maximum component norm of the discretization error is bounded by a constant times the square root of the mesh spacing. The constant depends on properties of the domain and bounds on third derivatives of the solution. (auth)

35829 (WAPD-TM-710) THE FINK/PANTRY DATA STORAGE AND RETRIEVAL SYSTEM FOR A COMPUTER. Bohl, H. Jr.; Marlowe, O. J. (Bettis Atomic Power Lab., Pittsburgh, Pa.). May 1967. Contract AT(11-1)-Gen-14. 34p. Dep. CFSTI.

The FINK/PANTRY subroutines use a forward linked list structure in main storage to store and retrieve data. The data are stored in variable length blocks. Each chain in the list is assigned an identifier as is each block of data entered in the chain. The data are retrieved by using the two identifiers. Overflow of main storage to auxiliary storage is handled in a similar manner where the block of data moved to and from auxiliary storage is an entire chain. These blocks are also linked together in chains. The main storage structure is also used to provide dynamic allocation. (auth)

35830 (Y-1585) SOME AOQ AND AFI VALUES FOR THE DODGE AND TORREY CSP-3 CONTINUOUS SAMPLING PLAN. Hull, R. H. Jr. (Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant). July 7, 1967. Contract W-7405-eng-26. 176p. Dep. CFSTI.

Thesis. Submitted to Univ. of Tennessee, Knoxville.

The purposes of this study were to present a mathematical proof of the AOQ formula for the continuous sampling plan, CSP-3, and to apply this formula in deriving AOQ and AFI values for CSP-3. Because of the complexity of the AOQ formula and time consuming calculations involved, a computer program was written in Fortran IV language for the IBM 7090 computer in order to determine AOQ and AFI values. For each set of values generated, the per cent defective, p, ranged from 0.5 per cent to 50.0 per cent at increments of 0.5 per cent. The values of i used in this study ranged from 5 to 200 units, and the sampling rate, f, began with 5 per cent and terminated with 50 per cent at increments of 5 per cent. An assumption was made that i = k. The computer program was written in such a manner that AOQ and AFI values could be generated for a given i value at various levels of f and p with only one data card. Therefore, AOQ and AFI values other than those appearing in this study may be generated with this computer program. Curves for obtaining values of f and i for a given value of AOQL were determined. When compared to the corresponding CSP-2 values, an examination revealed that the i values for CSP-3 were reduced by about 4 units when AOQL is 2 per cent; at 3 per cent AOQL, the CSP-3 i values were about 3 units less than the CSP-2 values; and for AOQL values greater than 3 per cent, the i values for CSP-3 were about 2 units less than the CSP-2 values. (auth)

35831 (LA-tr-67-49) THERMAL CONDUCTIVITY OF HELIUM AT TEMPERATURES FROM 273.65 TO 21.15°K AND PRESSURES FROM 0.101 TO 49.14 Mnewtons/M². Golubev, I. F.; Shpagina, I. B. Translated by J. Kerrisk (Los Alamos Scientific Lab., N. Mex.), from Gazov. Prom., 11: No. 8, 40-2(Aug. 1966). 6p. Dep. CFSTI. JCL $1.10 fs, $0.80 mf.

Measurements of the thermal conductivity of helium at temperatures from 273.65 to 21.15°K and pressures from 0.101 to 49.14 × 10^6 newtons/meter² (from 0 to 500 kgm/cm² gage pressure) were conducted by the method of regular heat regime in an apparatus using a modified double calorimeter. The outer cylinder of the double calorimeter was copper. The inner cylinder for measurements in the range of 273.65 to 78.15°K was also copper, and for measurements in the range 78.15 to 21.15°K was lead, since the heat capacity of lead is greater than the heat capacity of copper at these temperatures. This arrangement gave sufficient duration of cooling which allowed the determination of the thermal conductivity of helium by the regular regime method. (auth)

35832 I-CAN; International-Chromosome Analysis Newsletter, No. 1. Neurath, Peter W. (ed.) Vienna, International Atomic Energy Agency [1967]. 14p. IAEA.

International-Chromosome Analysis Newsletter (I-CAN) is prepared for the use of those engaged in computer-aided chromosome analysis. A report on the activities and discussions of a study group that met to consider the current status of the automation of karyotype analysis and a suggested list of pertinent references (19) are also included. (B.H.S.)